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NUCLEAR SCIENCE ABSTRACTS

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Volume 17, Number 13, July 15, 1963

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

21386 (BNL-789) BIBLIOGRAPHY OF TECHNICAL PUBLICATIONS AND REPORTS OF THE RADIATION DIVISION, BROOKHAVEN NATIONAL LABORATORY, 1951-1962 INCLUSIVE. D. S. Ballantine and L. E. Kopp (Brookhaven National Lab., Upton, N. Y.). Feb. 1963. Contract [AT(30-2)-Gen-16]. 4p. (BNL-L-338)

References (90) on radiation sources, dosimetry, applications, and research are given to journals, reports, and books published from August 1951 through 1962. (P.C.H.)

21387 (KR-42) QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1962. (Norway. Institutt for Atomenergi, Kjeller). Mar. 1963. 55p.

Work carried out at the Institutt for Atomenergi is described. Topics covered include: reactors, reactor development, neutron physics, fuel-element development, fuel reprocessing, research related to reprocessing, analysis, isotope production and development, health physics, and the Netherlands-Norwegian Reactor School. (M.C.G.)

21388 (LNF-63/11) ACTIVITY AT THE NATIONAL LABORATORIES OF FRASCATI. Report No. 13, July 1, 1962–December 31, 1962. (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Feb. 1963. 40p.

The electron synchrotron operated at about 90% efficiency in 1962 with an average beam intensity at 1000 Mev of about 5×10^{11} quanta/min. Cryogenic work involved testing of a new liquefier, construction of a magnetic susceptibility thermometer, experiments on superconducting magnets, and construction of an adiabatic demagnetization facility. A r-f power-supply for the storage ring "AdA" was tested along with an amplifier for the electron synchrotron. The effect of electron loading on the accelerating cavity was theoretically studied. Fast coincidence and gating circuits, a pulse height digitizer, a spark chamber films semiautomatic reading table, a saw-tooth generator, and various other apparatus were developed. For pulse height digitalization, a fully-transistorized convertor that accepts pulses from 50 mv to 0.8 v at 10 + 40 ns width was developed. A transistorized binary decade counter was also developed, and correct decoding for the decimal counter was achieved. A smaller frame for the pulse magnets proved insufficient; a 135 kjoule condenser bank was designed; Nb–Zr superconducting magnets were tested; α-radiation effects on superconductors were studied; and an electron gun was tested. Improvement of construction techniques for image-intensifying tubes was studied. A card-type input-output unit was installed permitting the statistical elaboration of experimental data. Work on didactic activity continued. The calculation that includes the contributions of hard photons in the production of pairs of μ mesons in electron-positron collisions was completed. Calculations on η meson decay were made, particularly the decay ratios of two γ's to three π's, and to two π's plus γ. Classification of leptons was investigated, and a study of weak interactions concerning inelastic processes induced by fast neutrinos was concluded. Data relative to μ^- capture were found to disagree with theoretical models for this process. Activities of the health physics and other supporting services are reported. (D.C.W.)

21389 (MLM-1145) MOUND LABORATORY PROGRESS REPORT FOR NOVEMBER 1962. J. F. Eichelberger, G. R. Grove, L. V. Jones, and E. A. Rembold (Mound Lab., Miamisburg, Ohio). Nov. 30, 1962. Contract AT(33-1)-Gen-53. 39p.

Two conductive epoxy adhesives were developed with adequate electrical conductance. The epoxy can be homogenized by mixing the components in 30 to 60 gram batches. The gamma spectra of naturally occurring radioactive isotopes is being compiled. The spectrum of each pure isotope and of each isotope in the presence of its daughters will be obtained. An isotopic analysis of the polonium produced in the MTR reactor was completed. The MTR neutron flux is responsible for the high Po^{208} content of these samples. The production of Po^{208} in small quantities by neutron irradiation of bismuth seems feasible. Recycling the polonium would gradually increase the Po^{208} inventory. The separation of U^{234} from aged Pu^{238} was demonstrated. Approximately 94% of the plutonium can be recovered by an anion exchange resin and solvent extraction with methyl isobutyl ketone. The remainder of the plutonium can be removed by extraction with thenoyltrifluoroacetone. Prior to enrichment by thermal diffusion more than 150 liters of He^3 were passed through the purification system to reduce the impurities. The total impurities were less than 100 ppm and the tritium content was 8.8×10^{-16}% in the product. Cryogenic techniques are being evaluated to separate He^3 from He^4. Taking advantage of the superfluid characteristics of He^3, a filter is being evaluated to quantitatively separate these isotopes at temperatures near absolute zero. The thermal diffusion systems to enrich the C^{13} fraction in natural methane produced a product containing 30% C^{13}. The purification system to remove impurities in methane produced a product containing greater than 99% methane. The viscosity of a liquid hypoeutectic plutonium-iron alloy (1 at.% Fe) was measured from 628 to 815°C.

The viscosity of this alloy was slightly below that for pure plutonium. The viscosity of a plutonium-iron eutectic alloy (9.5 at.% Fe) previously measured in the Mound viscosimeter, exhibited a viscosity much higher than pure plutonium. An alternate method of plotting viscosity data ($\log \eta - vs - 1/T$ instead of the conventional $\log \eta - vs - 1/T$) was utilized for all the liquid metals previously measured in the Mound viscosimeter. An estimate of the coefficients for self-diffusion for lead zinc from the viscosity data compares favorably with the literature values for self-diffusion of these two metals. A transient method for the measurement of the thermal conductivity of materials at elevated temperatures is being investigated. Although spurious electrical and thermal effects in the measuring circuit were not completely eliminated, some success was obtained in the determination of the thermal conductivity of nickel up to 500°C. Intermetallic structure analysis of the compound $CeCu_4$, which occurs as a primary phase in the plutonium-cerium-copper ternary system, eliminated all of the possible unit configurations except orthorhombic and tetragonal. The calibration curve which relates the area under a peak on a differential thermal analysis trace to the number of calories in the phase transformation was further refined when the heats of fusion of lead and indium were determined experimentally. This calibration curve is completed from 25 to 1000°C. With these curves as a reference, the heat of transformation of two plutonium samples were in excellent agreement with the values obtained from the high-temperature calorimeter. Uncalcined, reactor grade zirconium dioxide was found by x-ray analysis to contain two phases; a monoclinic phase and a phase similar to stabilized cubic zirconium dioxide. Heating this material in air at 1350°C caused complete disappearance of the cubic phase. Translucent microspheres of pure ZrO_2 were produced in the induction-coupled plasma torch at 50% oxygen-50% argon atmosphere. The spheres contained only a few monoclinic crystals as shown by x-ray analysis. The remainder of the ZrO_2 was cubic. A 5 wt % plutonium dioxide, 95 wt % zirconium dioxide mixture was melted in the plasma torch under oxidizing conditions. X-ray analysis indicated only the monoclinic zirconium dioxide phase. A 45 wt % zirconium dioxide solid solution was prepared by melting a pellet of the mixture under oxidizing conditions in the plasma torch. X-ray analysis of this material indicated only a cubic phase. Sodium borohydride is being evaluated as an analytical reagent to precipitate heavy metal cations from nitric acid solutions. Nickel, bismuth, iron, copper, silver, antimony, and tellurium were reduced and precipitated from plutonium solutions. Potassium sulfate is being evaluated as a reagent to quantitatively separate plutonium from aqueous solutions. Preliminary results indicate that a compound, potassium plutonium sulfate, is quantitatively precipitated by the addition of potassium sulfate and sulfuric acid. Four samples of Ac^{227} were measured in calorimeters. The half life of actinium was calculated to be 21.7708 years with an internal probable error of 0.0018 year and an external probable error of 0.0024 year. (auth)

21390 (NP-12729) LITERATURHINWEISE ZU RECHTS- UND WIRTSCHAFTSFRAGEN DER ATOMENERGIE DER RAKETENTECHNIK DER WELTRAUMFAHRT. NR. 8. ZUGÄNGE DER WISSENSCHAFTLICHEN SAMMLUNGEN IN DER ARBEITSSTELLE FÜR TECHNOLOGISCHE DOKUMENTATION (15.7.1962-28.2.1963). (Literature References on Legal and Economic Questions on Atomic Energy, Rocket Technology, and Space. Number 8. Accessions of Scientific Summaries in the Working Group for Technological Documentation, July 15, 1962-February 28, 1963). (Kernforschungsanlage, Jülich, Germany). Mar. 1963.

Approximately 364 references on the economic and legal aspects of atomic energy, rocket technology, and space are given to books, journals, and reports published from 1958 through 1962. (P.C.H.)

21391 (NP-12737) ANNUAL PROGRESS REPORT, 1962. (India. Atomic Energy Establishment, Trombay). 28p.

The development and expansion of the activities at the Atomic Energy Establishment at Trombay are discussed. Topics covered include: production facilities, reactors, physics, electronics, chemistry, metallurgy, and biology. (M.C.G.)

21392 (NP-12749) LIST OF PUBLICATIONS AVAILABLE TO THE PUBLIC. CUMULATION NO. 7, JANUARY-DECEMBER 1962. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1963. 108p.

References (1464) are given to reports, journals, books, and translations listed during 1962 on subjects of interest to nuclear science. Separate author and report number indexes are included. (P.C.H.)

21393 (NRL-5814) THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES. Second Annual Progress Report. V. R. Piatt and J. C. White, eds. (Naval Research Lab., Washington, D. C.). June 26, 1962. 97p. (AD-284576)

Research and development effort on the atmospheric habitability of submarines is reported. Emphasis is at present being placed almost exclusively upon atmospheres in nuclear-powered submarines. Progress is reported in efforts to develop the sulfate-cycle system for the electrolytic generation of O_2 from water and the absorption of CO_2, improved methods for producing chlorate candles and increasing their O_2 content (and output), and improved methods of sampling and analyzing atmospheres. Other topics covered include the use of algae for O_2 production and CO_2 absorption, Freon and general-purpose leak detectors, properties of monoethanolamine (MEA), catalytic combustion studies using hopcalite, and removal of aerosols with electrostatic precipitators. (auth)

21394 (ORNL-3300(Vol.2)) PUBLICATIONS, REPORTS, AND PAPERS FOR 1962 FROM OAK RIDGE NATIONAL LABORATORY. K. O. Johnsson and Ann S. Klein, eds. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 248p.

The titles of written and oral scientific information originating at ORNL during 1962 are listed. The publications are listed by division with each list divided into 5 categories: books, journal articles, papers at professional meetings, reports, and theses. A key-word index and an author index are included. (M.C.G.)

21395 (PNE-213F) SEISMIC EFFECTS FROM A HIGH YIELD NUCLEAR CRATERING EXPERIMENT IN DESERT ALLUVIUM. W. V. Mickey (Coast and Geodetic Survey, Washington, D. C.). Feb. 1963. Project 2.03 of PROJECT SEDAN. 64p.

SEDAN was a thermonuclear cratering experiment with a yield of about 100 kt detonated at a depth of 660 feet and resulting in a crater of maximum apparent depth of 320 feet and average apparent diameter of about 1200 feet. About 7.5 million cubic yards of earth and rock were displaced.

Transitory earth particle motions were on an average twice as large from stations on deep alluvial deposits compared to those on shallow deposits at the same distance. Computed seismic energy was about 2.45×10^{18} ergs, equivalent to a local earthquake magnitude of 4.75. This indicates that 0.06 percent of the total source energy was converted to seismic energy. Frequency analysis revealed spectral peaks near 1 cps. (auth)

21396 (PNE-217P) EJECTA STUDIES. W. A. Roberts and R. H. Carlson (Boeing Co., Seattle). Oct. 1962. PROJECT SEDAN. 62p.

One-hundred and forty-six ejecta measurement stations encircled ground zero at eight radial distances ranging from 373 to 1707 meters. The twenty-four sampling lines were spaced at fifteen-degree intervals. Data presented were recovered from stations located at radial distances of 640, 853, 1067, 1280, and 1707 meters. An attempt will be made to recover data at stations located closer to ground zero at a later time. Preliminary analysis of ejecta data indicates that areal density varies inversely as distance raised to the 3.64 power. Circumferential variation of areal density is about a factor of 30 at the 1707 meter radial distance, a factor of 10 at the 1280 meter radial distance, and a factor of 7 at the 853 meter radial distance. Cursory treatment is given to several related subjects, including outer limit of base surge dust deposit, volumetric ejecta densities, locations of natural missiles and impact craters, and the outer limit of ballistic debris. One case of missile damage to a reinforced concrete structure is documented. Raw data are included in the appendix. (auth)

21397 (PNE-224F) INFLUENCE OF A CRATERING DEVICE ON CLOSE-IN POPULATIONS OF LIZARDS. Frederick B. Turner (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Dec. 20, 1962. Project 62-85 of PROJECT SEDAN. 46p.

Prior to the Sedan test on July 6, 1962, the density of adult lizards northeast of the prospective ground zero was estimated on the basis of repeated sampling of selected areas. Samples were taken by hand collecting and by means of buried cans, which served as traps for both lizards and various species of arthropods. Measurements of cumulative gross gamma dosages in the study areas were also made at 2" and 36" above the ground, 2" below the ground, and in the tissues of lizards by means of small implanted glass microdosimeters. In shrubby areas northeast of ground zero, the pre-test density of Cnemidophorus tigris in June was estimated at 5 to 10 per acre, the density of Crotaphytus wislizeni at 1 to 2 per acre. No juveniles of either species were observed. Densities of Uta stansburiana and Phrynosoma platyrhinos could not be estimated from the data acquired. After the test, during August and again in November, no adult lizards were observed closer to ground zero than 5500 ft. (auth)

21398 (PNE-228P) CLOSE-IN EFFECTS OF AN UNDERGROUND NUCLEAR DETONATION ON VEGETATION. I. IMMEDIATE EFFECTS OF CRATERING, THROW-OUT, AND BLAST. W. E. Martin (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Project 62.89 of PROJECT SEDAN. 45p.

Operation SEDAN involved the detonation of a nuclear device at a depth of almost 650 ft in the alluvium of Yucca Flat, Nevada. Preliminary results are reported for studies dealing with the immediate close-in effects of this detonation on vegetation. (auth)

21399 (PNE-235F) SEISMIC VELOCITY STUDY. S. E. Warner (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 1962. Project 2.05 of PROJECT SEDAN. Contract W-7405-eng-48. 49p.

The performance of pressure-pulse transducers in determining distances of installed gages from small H.E. detonations by measuring seismic wave travel times was evaluated. Because of the superiority of the system time resolution as compared with conventional geophysical exploration equipment, improved accuracy was anticipated as well as an opportunity to dry-run the installed system in the operational environment. Also, a requirement for seismic velocity measurements in situ was fulfilled. Travel time measurements used satellite-hole gage placements, 5-pound C-4 detonations near the planned location of the device in the device hole, and operational diagnostic facilities. The results verified the original premise of the suitability of Plowshare instrumentation to determine with superior accuracy installed gage distances from the small H.E. detonations. Agreement of within 1% between surveyed distances and calculated distances was obtained for the three gage locations reporting. Seismic velocities obtained fell between 3825 and 3875 feet per second. Also, the experiment demonstrated the integrity of the Plowshare instrumentation system as installed. (auth)

21400 (TID-3716) INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Bibliographies Issued or in Progress During the Period, February–March 1963. (Division of Technical Information Extension, AEC). 25p.

Listings are included on AEC or AEC contractor bibliographies received by DTI Extension. A total of 124 entries is presented. (J.R.D.)

21401 (TID-18585) QUARTERLY PROGRESS REPORT NO. 69. H. J. Zimmermann, G. G. Harvey, and W. B. Davenport, Jr. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Apr. 15, 1963. Contract [AT(30-1)-1842]. 271p.

Research on microwave electronics, microwave spectroscopy, molecular beams, radio astronomy, noise in electron devices, plasma physics, plasma electronics, plasma magnetohydrodynamics and energy conversion, statistical communication theory, processing and transmission of information, artificial intelligence, speech communication, mechanical translation, linguistics, communications biophysics, neurophysiology, and neurology is reported. (D.C.W.)

21402 DECONTAMINATION OF THE E-20 LOOP IN NRU. S. P. Gibson, G. M. Allison, and J. F. Atherley (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Nucl. Tech., 2: No. 2, 50-2(1963).

A fuel failure occurring on Dec. 19, 1961, exposed uranium to water coolant in the E-20 loop. A decontamination procedure utilizing alkaline permanganate and oxalic–sulfuric acid solutions was used, taking care to prevent the permanganate from contacting the Stellite and Graphitar pump bearings. The average radiation level of the piping was reduced from 250 to 20 mr/hr by this procedure. The decontaminating solutions were analyzed for the radionuclides and the results are given. (D.L.C.)

21403 TECHNICAL FRUITS OF NUCLEAR RESEARCH. W. J. Oosterkamp (Philips Research Labs., Eindhoven, Netherlands). Philips Tech. Rev., 24: 1-13(Nov. 14, 1962). (In English)

In the past thirty years nuclear research has led to the development of numerous techniques, and some of their ap-

plications in various fields are discussed. Electrons of very high energy, e.g., from 4 to 35 million electron volts, can be used for medical irradiation, or for generating very hard x rays, which are used for the same purpose and also for industrial radiography. The electrons are obtained from accelerators, e.g., linear accelerators or betatrons. In nuclear reactors, or in cyclotrons, radioactive isotopes are produced which can be used as "tracers" in various investigations (examples: for the study of littoral drift, the absorption of iodine in the thyroid gland), for measurements based on the absorption of radiation (example: sand concentration in the outlet pipe of a sand dredger), for industrial radiography (welds in pipelines), or for medical therapy (cobalt irradiator). Mention is also made of neutron activation analysis. To illustrate the use of nuclear energy for the generation of electricity, some data are given on British and American nuclear power stations. The survey is preceded by a consideration of the hazards involved in nuclear engineering. With appropriate safeguards, the dangers are considered to be no greater or even less than are encountered elsewhere in engineering or daily life. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

21404 INTERCHANGEABLE COLLIMATORS IN MEASUREMENTS OF PERCUTANEOUS ABSORPTION OF LABELED COMPOUNDS. Torsten Fredriksson (Karolinska Sjukhuset, Stockholm). Acta Dermato-Venereol., 405-11(1962). (In English)

For use with techniques involving disappearance of radioactive materials applied to skin, a device was designed that makes it possible to use interchangeable collimators in measurements of the percutaneous absorption of such labeled compounds. Three different collimators with areas of 50, 135, and 380 mm^2, were used in experiments in which the rate of percutaneous absorption of tri-n-butyl phosphate was estimated in vivo. Its disappearance from a topical deposit of P^{32}-labeled material (25 μl applied on 4.1 cm^2) was followed in rabbits. It was shown that interchange of the collimators, which made it possible to adjust the counting rate to a suitable level, did not influence the slope of the disappearance curves which showed 3 phases. The initial rapid decrease was regarded to reflect changes in self-absorption of β rays, the second inconstant phase was assumed to reflect the delay period until maximum absorption is reached, while the third steady slope presumably represents maximum absorption into the blood stream. The mean rate of absorption of tributyl phosphate was calculated from the disappearance constant and was found to be 2.4 $\mu g\ cm^{-2}\ min^{-1}$ (9 $m\mu M\ cm^{-2}\ min^{-1}$). (TCO)

21405 LOCALIZATION OF RADIOACTIVITY BY INTRAVASCULAR INJECTION OF LARGE RADIOACTIVE PARTICLES. Edgar D. Grady, Walter T. Sale, and Luther C. Rollins (Piedmont Hospital, Atlanta). Ann. Surg., 157: 97-114(Jan. 1963).

It is proposed that intra-arterial injection of suitably sized large particles of radioisotopes may be a useful method of producing localized radiation effects, and data are provided to demonstrate this feasibility. Most of the investigations were made with Y^{90}, in the particle size range between 50 and 100 μ. Particles of appropriate size were prepared from pure Y_2O_3, which was pelleted by a hydraulic press, and the pellets mounted in a furnace and partially fused at about 2800°C. The fused portion was then crushed and screened through sieves to eliminate particles larger and smaller than the desired size. Each sample was then irradiated at 8×10^{12} neutrons per cm^2 or 4×10^{13} for from 14 to 30 days. Injections into the portal vein in rabbits showed that 100% of the particles were retained by the liver; there was homogeneous distribution throughout the organ, and no histologic damage was produced. In dogs receiving varying quantities of Y^{90} suspensions intravenously or into carotid artery, there was little trapping of isotope by the brain and there was no apparent brain damage, demonstrated clinically, histologically, or by electroencephalograms. Dogs tolerated intravenously up to 6 mC/kg of body wt. and were still alive in good health 7 months after injection. From 40 to 70% of the particles were trapped in the kidney or thigh muscles when the suspensions were injected into a renal artery or into a femoral artery of a rabbit. Ten to 25% of the amount passing through rabbit kidney or thigh was trapped in the lungs: the rest went to liver and spleen. After intravenous injections in dogs ~70% was trapped in lung, and the rest went to the liver and spleen. Results from treatment of 12 cancer patients with injections of Y^{90} particles showed that: the procedures were relatively simple; there were no complications or toxic effects due to radioisotopes; no patient had radiation sickness; the procedures were also relatively safe to hospital personnel; there was little, if any, spill of radioactivity in excreta; and there was a favorable concentration of Y^{90} in cancerous lungs and pelvic organs and there was immediate objective and subjective improvement in all cases. Localization in the liver was not so good as anticipated since there were considerable mechanical difficulties in injecting the material directly into the hepatic artery. (TCO)

21406 THE USE OF COBALT-60 FOR LABELING SNAILS IN THE STUDY OF FIELD POPULATIONS. G. Webbe and W. W. C. Read (Ministry of Health and East African Inst. for Medical Research, Mwanza, Tanganyika). Ann. Trop. Med. Parasitol., 56: 206-9(July 1962).

The use of Co^{60} as a label for pulmonate snails was investigated. A simple method of marking snails with Co^{60} and methods for detecting and estimating their radioactivity are described. The snails were immersed for 24 hr in 1 l of water containing 5 mC $Co^{60}Cl_2$. An estimation was made of the biological half life of Co^{60} in Bulinus (Physopsis) nasutus productus, and observations were carried out on the effects of a body burden of Co^{60} adequate for field studies over a prolonged period. An initial mortality of the snails occurred. The mean count/min/snail 24 hr after exposure was 212035, which is equivalent to a mean body burden of 20 μC snail. After an interval of 6 weeks the mean count was 35833, or 3.4 μC per snail, indicating a considerable loss of radioactivity during the initial period. Although there was considerable range in the radioactive level of individual snails, at the end of the observations all specimens were easily detectable with a radiation monitor (G-M tube, MX-108). Marked snails observed throughout the course of the experiment attained average expected size, and their breeding capacity was unimpaired. It was concluded that Co^{60} is a suitable label for snails, and is easily detectable in the field with simple portable apparatus for considerable periods after marking. (TCO)

21407 RADIOIODINE IN DIAGNOSIS AND THERAPY OF HYPERTHYROIDISM CAUSED BY HYPERFUNCTIONING THYROID ADENOMA. Penn G. Skillern, E. Perry McCullagh, and Marvin Clamin (Cleveland Clinic Foundation). Arch. Internal Med., 110: 888-97(Dec. 1962).

Of 46 patients having clinical hyperthyroidism caused by proved hyperfunctioning adenoma, as determined by I^{131} scintigrams 25 had normal 24-hr thyroidal I^{131} uptake values. The I^{131} scintigrams of the 46 patients revealed that only 1 hyperfunctioning adenoma of the thyroid was present in each goiter. No significant I^{131} uptake was observed in the normal thyroidal tissue outside of the adenoma. The results of therapy with an initial large dose I^{131}, delivering from 15 to 30 mC (average 21.4 mC) to the adenoma, showed that 76% of the patients were euthyroid within 2 months, and all 21 patients within 4 months, after treatment. In contrast, when a moderate initial dose of I^{131} delivering 6 to 14 mC (average 10.1 mC) to the adenoma was given to 38 patients with toxic nodular goiter (presumed hyperfunctioning adenoma) with hyperthyroidism, only 16% were euthyroid within 2 months and 53% within 4 months. In each of the 21 patients the hyperfunctioning adenoma decreased in size but did not disappear

after I^{131} treatment. No significant clinical exacerbation of hyperthyroidism occurred. No significant early or late radiation effect has yet been observed in any of the patients treated with I^{131}, and in none of the treated patients has hypothyroidism developed. (TCO)

21408 A NOTE ON RADIATION TREATMENT IN RELATION TO PERFORMANCE ON CERTAIN TESTS. C. B. Frisby (National Inst. of Industrial Psychology, London). Brit. J. Psychol., 52: 65-70(Feb. 1961).

A series of psychologic tests were conducted before, during, and after radiotherapy of a patient with carcinoma of the throat. Treatment consisted of a total of 6870 r delivered to the primary lesion by Co^{60} and supervoltage (2-Mev) x rays. Preliminary studies showed that irradiation of the pharynx led to loss of taste with decline of mental effectiveness. To further investigate the latter symptom, the following tests were conducted: Choice Reaction Time Test, Kraeplin Sheets, Cancellation Test, Fractions Test, and N.I.I.P. (National Institute of Industrial Psychology) Group Test 70/1. Although no definite conclusions could be drawn from the results, they did suggest a trend of mental impairment during the irradiation period that was reversed several months after completion of the treatments. It is recommended that similar studies be performed in larger numbers of persons undergoing radiotherapy. (H.H.D.)

21409 PROSPECTS AND PRESENT STATUS OF X-RAY MICROSCOPIC TECHNIQUES, DERIVATIVES OF MICRORADIOGRAPHY, PARTICULARLY IN THE PLANT FIELD. J. Salmon (Faculté des Sciences, Paris). Bull. Microscop. Appl., 11: 17-67(Apr. 1961).

Applications of x-ray techniques at the microscopic level are extensively reviewed, including historical, theoretical, and practical aspects. Possible future uses of microradiography are discussed, and numerous illustrations are provided. Experiments demonstrating the microscopic structure of human bone tumors and constituents in plant cells by microradiography are also described and illustrated. The visualization of various nuclear and cytoplasmic constituents is described, and the determination of the dry weight of cells from microradiograms is discussed. New data are given relating to the demonstration of Th deposits in human tissues by means of microradiography and by secondary emissions (photoelectrons) of irradiated Th in tissue sections. An appendix is provided in which apparatus used in microscopic x-ray techniques is described and illustrated. (H.H.D.)

21410 RADIATION SHIELDING OF THE OVARIES. K. Gefferth (Univ. of Budapest). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 98: 477-82(Apr. 1963). (In German)

Protectors for the ovaries which shield the whole of the small pelvis during radiotherapy are often of little value because of the need of visualizing the organs. Protectors are described which shield only the ovaries and do not obscure the other parts of the pelvis. It was established that a series of 12 protectors is perfectly adequate from birth until the postpuberty age. The values measured on the single protectors are tabulated. Measurements carried out on paraffine phantoms showed a reduction of radiation burden by 70 per cent. (auth)

21411 A NEW METHOD OF TREATMENT OF INTRINSIC CARCINOMA OF THE LARYNX BY IMPLANTATION OF RADIUM OR TANTALUM WIRE. Frank Ellis (Churchill Hospital, Oxford). J. Laryngol. Otol., 75: 811-20(Sept. 21, 1961).

A new method was developed to avoid damaging the cartilage and irradiating the perichondrium with as high a dose as is used in other methods, so as to reduce the tendency to necrosis. The γ radiation of Ra has a high energy and the dose increase resulting from the presence of Ca, which occurs with x rays below an energy of about 250 kv, does not occur. The sources used consisted of Rn seeds placed in hollow stainless steel needles, Ra needles, and radioactive Ta wire. The advantage of Rn seeds and Ta wire is that radioactivity is provided up to the very tip of the needle. The method is carried out by suitable surgical exposure of the thyroid cartilage down to the perichondrium. The Ra needles used are of 4-cm total length and 3-cm active length. At 1 cm higher, another needle is inserted parallel with the first needle, either by boring another hole in the thyroid cartilage, or pushing it through the thyrohyoid membrane. Below the first needle, at a distance of 1 cm, another needle is similarly inserted. When Ta wire is used, it is held in fine nylon tubing and placed in the same kind of way as Ra needles. The successful treatment of 10 out of 12 cases of carcinoma of the vocal cords is described. (TCO)

21412 RECENT STUDIES IN THE PHARMACEUTICAL CONTROL OF RADIOELEMENTS. Y. Cohen and J. Ingrand (CEN, Saclay, France). J. Med. Bordeaux Sud-Ouest, 138: 1003-9(Aug. 1961).

The preparation, properties, radioactivity, and biologic control of 3 radioactive solutions for medical use are described in detail. The 3 preparations considered are solutions of $Na_2Cr^{51}O_4$, $Fe^{59}Cl_3$, and $(NH_4)_2HAs_{.6}O_4$ (sodium chromate, ferric chloride, and ammonium arsenate). Cr^{51} (half-life 27.8 days) was prepared from potassium chromate by the Szilard-Chalmers effect in the course of neutron bombardment, Fe^{59} (45 days) by irradiation of Fe^{58} enriched by electromagnetic separation, and As^{76} (26 hr) by irradiation of cacodylic acid. Methods are described for identification of the isotopes and evaluation of their radiochemical purity. Cr^{51} for use in hematologic studies (labeling erythrocytes) must contain less than 0.1% radioactive impurities. Rb^{86} was found in some preparations of Cr^{51} and must be removed since it has been found, like K, to enter erythrocytes. Fe^{59} preparations should contain less than 10% Fe^{55} because of the long half life (2.6 yr) of the latter, resulting in prolonged internal irradiation of clinical subjects. The As^{76} preparation should contain less than 0.1% radioactive impurities as ascertained by γ spectrometry. The minimum specific activities of the 3 preparations should be 15 mC/mg for Cr^{51}, 1 mC/mg for Fe^{59}, and 20 mC/mg for As^{76}. Paper chromatographic techniques for evaluating the radiochemical purity of the isotopes are described in detail. Methods for testing the isotopic solutions destined for medical use are also considered, including the criteria for sterility, innocuousness, and selectivity of labeling of biological structures. (H.H.D.)

21413 INTRAVENTRICULAR RISA (RADIOIODINATED SERUM ALBUMIN) AS A DIAGNOSTIC AID IN PRE- AND POSTOPERATIVE HYDROCEPHALUS. James R. Atkinson and Eldon L. Foltz (Univ. of Washington, Seattle). J. Neurosurg., 19: 159-66(Feb. 1962).

A technique is described for evaluating the presence of hydrocephalus by measurement of the decrease in RISA concentration in ventricular cerebrospinal fluid from the 1-hr level at 4 hr and 24 hr following injection of a 5-mC test dose. The technique was found satisfactory in classifying normal, active hydrocephalic, and arrested hydrocephalic patients. Concentration of radioactivity in blood was found to be too low to be generally useful. In patients

with ventriculoatrial shunts, radioactivity in blood frequently showed a sudden surge, indicating a functioning shunt. The variable finding depended apparently on time of sampling and rate of flow in the shunt. The 1-hr concentration of RISA in ventricular cerebrospinal fluid was an unreliable index of activity of hydrocephalus. Concentrations of RISA in lumbar cerebrospinal fluid were an unreliable index of concentration of RISA in ventricular cerebrospinal fluid. A model is proposed for the dynamic characteristics of the cerebrospinal fluid-protein system. It is proposed that the most common basic defect in hydrocephalus is a critical reduction in area of available subarachnoid space where interfaces allow cerebrospinal fluid-brain mechanisms of transfer to take place. (H.H.D.)

21414 PHOTO X-RAY: A NEW METHOD OF RECORDING THE SKELETAL STRUCTURE OF THE HAND. J. G. Parish and H. E. Duggan (Univ. of Alberta Hospital, Edmonton, Can.). Lancet, 2: 562-3(Sept. 15, 1962).

A simple, rapid method for obtaining radiographs of the hand is described. Kodak rapid polycontrast double weight matte-surface photographic paper is placed in an ordinary cassette and a conventional x-ray exposure is made. The paper is developed in the usual way and a direct negative print is produced. The method has the disadvantage of requiring a relatively high radiation dosage. The skin radiation dosage was estimated at 342 Mr for the photographic method compared with 10 Mr for standard radiograph of the hand. The reproduction of details of bone structure has proven as good as with standard radiographs. Another, faster method using Polaroid film is also described. This method still has certain disadvantages. A positive print is obtained; the bones are black and the surrounding tissue white. Bone outlines are not so well defined as with the first method. However, an exposure of only 10 sec is required as compared with 5 min by the first method or using standard x-ray film. (H.H.D.)

21415 MODIFICATION OF LIVER METABOLISM IN THE HYPOPHYSECTOMIZED RAT. I. UTILIZATION OF UNIFORMLY TAGGED GLUCOSE C^{14} IN THE LIVER OF NORMAL AND HYPOPHYSECTOMIZED RATS. V. Ricotti, G. Cevini, and N. Di Marco (Università, Pavia, Italy). Minerva Nucl., 7: 10-14(Jan.-Feb. 1963). (In Italian)

A study has been made of the possible changes induced by hypophysectomy on the utilization of glucose C^{14} by hepatic tissue in the rat. The findings show that hypophysectomy does not result in a fall in the total uptake of the labeled substance although it does lead to an intensification, in the hepatic tissue of the hypophysectomized rat, of the exudative processes at the expense of intracellular synthesis. This is reflected in the increased production of $C^{14}O_2$ and reduced residual cellular radioactivity. (auth)

21416 MODIFICATION OF LIVER METABOLISM IN HYPOPHYSECTOMIZED RATS. II. UTILIZATION OF ACETATE-1-C^{14} IN LIVER OF NORMAL AND HYPOPHYSECTOMIZED RATS. V. Ricotti, G. Cevini, and G. Doneda (Università, Pavia, Italy). Minerva Nucl., 7: 14-18(Jan.-Feb. 1963). (In Italian)

The utilization of acetate-1-C^{14} by the hepatic tissue of the hypophysectomized rat has been studied in order to determine the possible changes in lipid metabolism induced by hypophysectomy. The findings suggest that hypophysectomy does not produce apparent changes in lipid metabolism. (auth)

21417 METHOD FOR THE DETERMINATION OF THE HEMATOCRIT OF AN ORGAN IN VIVO. Guido Cultrera (Università, Pavia, Italy). Minerva Nucl., 7: 32-6(Jan.-Feb. 1963). (In Italian)

A method, based on the almost simultaneous labeling of the plasma with Cl_3Cr^{51} and of the red blood cells with $Na_2Cr^{51}O_4$, is described, by which the hematocrit can be measured in vivo. The patient's plasma is labeled, and the radioactivity is then almost simultaneously measured in vivo over the organ considered, e.g., the heart; the plasma radioactivity is measured in a sample of blood taken from a vein. The same procedure is then repeated considering the radioactivity of the red blood cells. By applying a formula, the hematocrit of the examined organ can then be calculated. The results of measurements of the cardiac hematocrit were fairly satisfactory as compared with measurements of the venous hematocrit and showed that two factors are of fundamental importance in order to obtain accurate measurements. Highly sensitive counters must be used and relatively large doses of isotope must be employed. Unless these conditions are observed, results will be unsatisfactory on account of the high statistical error. (auth)

21418 CUNEIFORM FILTERS FOR CESIUM THERAPY. TECHNICAL NOTE AND PRELIMINARY IONIMETRIC DATA. F. Bono, C. Rimondi, and V. Voci (Università, Bologna). Radiobiol. Radioterap. Fis. Med., (3) 17: 374-83(Sept.-Oct. 1962). (In Italian)

The technical features and the first results in ionimetric measurements obtained using cuneiform filters installed on a 2000 curies–Cs-137 unit are discussed. Experiments were carried out using two 5° by 12° lead filters by field opening of different widths (6 × 6 cm, 9 × 9 cm, and 15 × 15 cm) and a 40 cm SSD. In one series of experiences the screening involved the whole field surface, while in another series only half the field was shielded. The deformation of the isodose curves obtained with the filters proved to be larger by 12° wedges and increases in progression with the increase of field width. (auth)

21419 EFFECTIVENESS OF X-RAY THERAPY IN PELLEGRINI-STIEDA SYNDROME. M. Michellacci and G. Sanna (Università, Parma, Italy and Ospedale Civile, Cesena, Italy). Radiobiol. Radioterap. Fis. Med., (3) 17: 384-400(Sept.-Oct. 1962). (In Italian)

A brief review is presented of the etiopathogenetic interpretation of Pellegrini-Stieda's syndrome, and its clinical and radiological picture. The therapeutic possibilities available, particularly the use of physiotherapy, and the probable modality of biological action are discussed. The results obtained with roentgentherapy in a group of patients with an old lesion whose radiological picture was very conspicuous are presented. The result of the treatment was always excellent, so that none of the patients showed any sign of recurrent symptomatology a year after the end of therapy. (auth)

21420 RADIATION THERAPY WITH HIGH SPEED-ELECTRONS. A. Zuppinger (Universität, Bern). Radiol. Clin., 31: 129-40(1962).

The advantages of high-speed electron therapy over electromagnetic and x ray therapy are discussed. A survey of physical, biological, and clinical data obtained from 602 patients indicated that high-speed electrons are more effective than electromagnetic irradiation in many tumor cases. The patients were observed for at least 1 yr up to $4\frac{1}{2}$ yr after curative or palliative electron therapy. Since high-speed electrons give a uniform deep dose and the depth can be chosen by changing the voltage, it is very useful with many types of tumors and is less injurious to radiosensitive normal tissues. Experiments in rats showed changes in the uptake of Ca in the spongiosa of tibia and femur according to the dose of irradiation administered. Clinical observation showed that by using the same dose,

skin and subcutaneous tissues are better protected by high-speed electrons than with electromagnetic irradiation. Favorable therapeutic results were obtained in ⅓ of the patients treated with high-speed electrons. Particularly good results were observed in carcinomas of larynx, thyroid, breast, and brain. It is especially useful for preoperative treatment, and complications following surgery were fewer after high-speed electron than x-ray therapy. (TCO)

21421 ENDOLYMPHATIC RADIOTHERAPY: TECHNICAL AND PHYSICOBIOLOGICAL ASPECTS. G. L. Buraggi, P. d'Amico, and G. Fava (Università, Milan). Radiol. Med., 49: 238-73(Mar. 1963). (In Italian)

The physical and biological bases of radiotherapy of the lymph nodes by means of endolymphatic administration of Lipiodol F tagged with I^{131} are discussed. After giving the reasons which suggested the use of this preparation and the techniques adopted to reduce irradiation of the operators to a minimum, the methods used for measuring the radioactivity in order to estimate the concentrations reached by the radionuclide in the various foci, organs, and body as a whole, and also the dose absorbed are discussed. It was established that administering activities of the order of 10 to 15 mc, high foci doses can be reached in the foci without the body absorbing dangerous doses. The reduction in volume of the lymph nodes was marked and no changes of the hematic crasis or hepatic function was seen in the patients treated. (auth)

21422 FACTORS WHICH AFFECT EFFICIENCY OF AUTORADIOGRAPHY WITH TRITIATED THYMIDINE. Renato Baserga and Ken Nemeroff (Northwestern Univ., Chicago). Stain Technol., 37: 21-6(Jan. 1962)

An investigation of the overall efficiency of autoradiography with thymidine H^3 revealed that efficiency is influenced by: exposure in an atmosphere of CO_2 and the use of the stripping-film technique, both of which increase the autoradiographic efficiency when compared to exposure in air or to dip-coating technique; latent image fading, which increases with increasing exposure; the thickness of the inert coating interposed between the labeled locus and the sensitized emulsion. A layer of inert coating can be obtained that will arrest all beta particles from tritium, while having no effect on more energetic emitters like C^{14}; the amount of tritiated thymidine given, with relatively large amounts producing an increase in the mean grain count per labeled cell but not in the percentage of cells identifiable as labeled; and the type of fixative and the staining procedure used. Feulgen stain reduces the mean grain count in cells labeled with radioactive thymidine, while fixation with acetic acid–alcohol (1 : 3) reduces the grain count in cells labeled with precursors of RNA. (TCO)

21423 HUSK IN CATTLE: LABORATORY AND FIELD STUDIES ON CALVES VACCINATED WITH IRRADIATED LUNGWORM LARVAE. R. L. Cornwell (Univ. of Liverpool, Eng.). Vet. Record, 74: 622-8(June 2, 1962).

The successful use of vaccine consisting of x-irradiated Dictyocaulus viviparus larvae, in 134 calves under farm conditions during 1959-61, is described. The vaccine was safe for use in normal calves and in calves suffering a mild virus pneumonia. Adequate larval attenuation was shown by absence of patent infections and very little affect on respiratory rate. Experimental challenge with 5000 to 10000 larvae in 10 calves resulted in mild symptoms but a 2-fold increase in respiratory rate. Natural pasture challenge of calves produced similar mild symptoms except after sudden exposure to a very heavy pasture challenge. The evidence presented indicates that the vaccine used is quite safe to use, in that its pathogenicity is negligible. The failure to find lungworm larvae in repeated fecal samples from calves during the vaccination process indicates that the level of irradiation used effectively attenuates the larvae and prevents them completing their development to the fertile adult stage. There was no direct connection between the titer and the height of the maximum respiratory increase after vaccination. (TCO)

21424 USE OF RADIOACTIVE TRACERS IN THE STUDY OF INSECT-PLANT RELATIONSHIPS. D. A. Crossley, Jr. (Oak Ridge National Lab., Tenn.). IAEA Preprint No. SM-40/35. 19p.

To be published in IAEA Proceedings of the Symposium on the use and Application of Radioisotopes and Radiation in the Control of Plant and Animal Insect Pests, held in Athens, Greece, April 22-26, 1963.

In early ecological investigations of insect pests, dispersion and migration phenomena were studied with radioisotopes as markers for individual insects. A more recent development is the use of radioisotopes to evaluate insect-plant and predator-prey associations through estimates of food utilization. Biological elimination of radioisotopes, a nuisance in dispersion studies, is being utilized as a measure of feeding rates. In both field and laboratory experimentation, insects were allowed to reach steady-state concentrations of radioisotopes through feeding activities. Measurements of elimination rates (biological half-lives) permitted the steady-state concentrations to be translated into intake rate functions. Food consumption studies were performed for single insect species populations and for multiple species populations. In a single species investigation radiocesium in a tagged field site was used to estimate consumption of willow leaves by populations of the beetle Chrysomela knabi. Direct measurements of food consumption made in the laboratory showed good agreement with field estimates of feeding rates based on the radioisotope techniques. Biological half-lives differed for the larval stages and these had to be considered separately. Radioisotopes provided a means for separating overwintering adults from newly emerged ones, through the more rapid elimination of cesium from overwintering insects. (auth)

21425 RADIOTRACER APPROACHES TO CARBAMATE INSECTICIDE TOXICOLOGY. J. E. Casida (Wisconsin. Univ., Madison). IAEA Preprint No. SM-40/38. 24p.

To be published in IAEA Proceedings of the Symposium on the Use and Application of Radioisotopes and Radiation in the Control of Plant and Animal Insect Pests, held in Athens, Greece, April 22-26, 1963.

A review is presented of the information obtained from radiotracer studies of carbamate insecticides. The emphasis is on detoxification mechanisms. Areas where tagged molecules may be most effectively used are pointed out. (67 references) (T.R.H.)

21426 THE RENAL EXCRETION OF CALCIUM AND STRONTIUM. Jay Robert Georgi. Thesis. Ithaca, N. Y., Cornell Univ., 1962. 75p.

In a series of exploratory experiments designed to study the influence of age, sex, ammonium-chloride feeding, and dietary Ca and P content on the excretion of Sr and Ca by the rat kidney, it was noticed that low discrimination between Sr and Ca was always associated with high Ca excretion rates and vice-versa. A Sr/Ca excretion model was formulated which suggested an experimental approach to the study of this relationship. The postulates and development of the model are outlined. According to this model, any reduction in the efficiency of Ca reabsorption should result in increased Ca and Sr excretion rates and a reduction in the

$OR_{(urine/filtrate)}$. In order to reduce the efficiency of Ca reabsorption and thus test the model, stable Ca solutions were injected intravenously into 2 goats at rates sufficient to cause overloading of the tubular reabsorptive mechanism for Ca. The anticipated fall in the $OR_{(urine/filtrate)}$ to unity, associated with the greatly augmented Ca excretion rate, was observed following the start of stable Ca infusion in the initial experiments. Next, inulin clearance and plasma ultrafiltration techniques were added to the procedure of 3 more experiments to make possible the determination of Ca and Sr glomerular filtration rates and calculation of the efficiency of Ca and Sr reabsorption by the renal tubules. As expected, the efficiency of tubular reabsorption of both Sr and Ca fell when stable Ca (and when stable Sr) was infused. A precise mathematical model relating renal discrimination and Ca excretion rate was formulated using data supplied in a separate paper on the dependence of Sr reabsorptive efficiency on that of Ca. (M.P.G.)

Biochemistry, Nutrition, and Toxicology

21427 (AEET/AM/32) GAMMA ACTIVITY OF THE FOOD SAMPLES IN INDIA AFTER THE AUTUMN 1961 TESTS OF NUCLEAR WEAPONS. A. S. Deshpande and K. G. Vohra (Atomic Energy Establishment, Trombay). 1963. 20p.

After the resumption of nuclear weapon tests in September, 1961 several samples of foods, including vegetables, milk, fruits, grains and composite meals were studied for their radioactive content. The measurements were made using a low-level gamma-ray scintillation spectrometer. Several freshly produced short lived fission products were identified in the gamma spectra of these samples. Quantitative estimation of some of the important short lived fission products was carried out. The data on the fission products (Zr-95 + Nb-95), Ce-141, Ce-144, Ru-103, Ru-106, and Cs-137 in various samples are presented. Data on gross gamma activity of the samples and the gamma activity due to natural potassium are also presented. The fission products (Zr-95 + Nb-95) contribute about 25% of the total activity in fresh fallout and the other fission products given above together contribute another 25% of the activity in fresh fallout. The maximum level of (Zr-95 + Nb-95) in vegetables is found to be about 18% of the level which would give a dose above the acceptable limit for continuous consumption. The other isotopes show comparatively smaller fraction of acceptable levels. (auth)

21428 (JPRS-18936) ELIMINATING RADIOSTRONTIUM FROM THE ORGANISM. V. S. Balabukha and N. O. Razumovskii (Razumovskiy). Translated from Med. Radiol., 7: No. 3, 71-6(1963). 8p. (OTS-63-21695)

Methods of preventing resorption and of enhancing the elimination of Sr^{90} are discussed. It is pointed out that Sr is very rapidly absorbed through the intestinal walls after oral administration and that it accumulates in zones of active growth in bone. When Sr^{90} enters through the respiratory tract it is quickly absorbed by blood. Mechanical removal by means of stomach pump, administration of emetics, laxatives, and the use of various agents combining with Sr are first aid measures for use in Sr poisoning. Ion exchange resins, pectins, and the sulfates of Na and Mg all increase intestinal elimination in varying degrees. A diet rich in Ca helps to prevent skeletal deposition of Sr and a low Ca diet was found to speed removal of the Sr fixed in bone. Results are reported from tests on a number of chemical compounds for their effectiveness in removing Sr from blood and bones. None of the compounds or hormones tested increased the elimination of fixed radioactive Sr to any great extent. 48 references. (C.H.)

21429 DISTRIBUTION AND KINETICS OF SODIUM (Na^{22}) IN MICE AND RABBITS. A. Huggert, E. Odeblad, R. Soremark, and S. Ullberg (Medical School, Omea, Sweden; Sabbatsberg Hospital, Stockholm; Royal School of Dentistry, Stockholm; and Veterinary School, Stockholm). Acta Isotopica, 1: 151-72(1961). (In English)

The distribution and kinetics of Na^{22} in mice and rabbits were studied autoradiographically and by scintillation counting at various intervals after an intravenous injection of Na^{22} in an isotonic solution. The amount of Na^{22} after the steady state was reached was highest in teeth among the various organs and tissues studied and decreased in the order: teeth, cartilage, bone, urine, papillary muscle, blood vessel walls, blood, gall bladder contents, lung, kidney, amniotic fluid, heart muscle, skin, fetal brain, brain, salivary gland, intestinal contents, feces, liver, gastric mucosa, muscle, gastric contents. The kinetics of sodium in the mice and rabbits was very rapid. The steady state was reached for most of the tissues within a few minutes. The build-up of Na^{22} in teeth, brain, and bones was, however, extremely prolonged. The uptake of Na^{22} in the fetal brain and spinal cord was significantly higher than that in the maternal brain and spinal cord. (P.C.H.)

21430 COMPARISON OF INTRAVENOUS INFUSION OF STABLE STRONTIUM WITH THE CALCIUM TOLERANCE TEST. Gianfranco Mazzuoli, Ezio Biagi, and Giorgio Coen (Università, Rome). Acta Med. Scand., 170: 21-30(1961). (In English)

Data obtained by the calcium tolerance test (Ca TT) were compared with those obtained with the intravenous administration of an equivalent amount of stable Sr in 9 human subjects. Urinary Ca excretion increased in all subjects on the day of Sr (977 mg) infusion. The sum of the increase plus the amount of Sr excreted equaled the amount of the excess urinary Ca observed on the day of the Ca TT. In all subjects the percentage of Sr excreted was always less than that for Ca. On the days following the infusion, the elimination of Sr decreased exponentially from the 24th or 48th hr. After 7 days, the total quantity of Sr eliminated was between 6 and 43% of the administered dose. Plasma Sr levels rose gradually, reaching at the end of the infusion a peak of 10% of the infused dose per total plasma volume and declined thereafter with time. Plasma levels of Ca also increased, reaching a peak at the second hr and returning to the control values in 6 to 8 hr. From these results, it appears that the sum of the increased calciuria and of the Sr excretion, similarly to the excess calciuria following the Ca TT, are an indication of the skeletal capacity to retain Ca. Moreover, the ratio of Sr excretion to the increase in calciuria on the day of Sr infusion was an index of the magnitude of the exchangeable pool. It appeared that Sr has the same effects as Ca on the parathyroid glands, and that its metabolism is controlled by the same homeostatic mechanism as that of Ca. (TCO)

21431 URINARY RADIOIODINE EXCRETION IN THE MALNOURISHED INFANT. R. D. Montgomery (Cambridge Univ., Eng.). Arch. Disease Childhood, 37: 383-6(Aug. 1962).

A study of urinary I^{131} excretion and its relation to basal oxygen uptake was conducted in Jamaican infants suffering from, and recovering from, severe protein malnutrition. Because of the possible radiation hazard of I^{131} in young children, a dosage of 0.01 μC/kg was used. The calculated

mean radiation dose to the gland was of the order of 0.25 rad. The small dosage precluded the estimation of thyroid gland uptake or serum I^{131} activity. In the initial phase of hospital admission for malnutrition, I^{131} excretion was essentially normal. During recovery some cases showed a decrease in excretion. The decrease, however, was unrelated to dramatic increases in oxygen uptake and body weight and tended to lag behind them. It was concluded that thyroid action may facilitate, but in no way initiates, the accelerated respiratory activity during recovery, and that in the initial malnourished state thyroid activity is within normal limits. (H.H.D.)

21432 EFFECTS OF DEUTERIUM ON THE THERMAL TRANSITION OF NUCLEIC ACIDS. H. R. Mahler, Gary Dutton, and B. D. Mehrotra (Indiana Univ., Bloomington). Biochim. Biophys. Acta, 68: 199-210(Feb. 26, 1963). (In English)

The thermal helix → coil transition of 3 different DNAs and 4 different RNAs in H_2O and D_2O solutions was studied by means of absorbancy–temperature profiles. There is no significant difference in total hyperchromicity, the midpoint or the width of the transition, even after extensive preincubation of the nucleic acid at elevated temperature in the fully deuterated medium. This absence of any isotope effect for denaturation is also independent of base composition, which varied from 35.2 to 65, and 40 to 64 mole % (guanine plus cytosine) for DNA and RNA, respectively. In a medium containing $1.5 \cdot 10^{-3}$ M NaCl, $1.5 \cdot 10^{-4}$ M sodium citrate, and $1.0 \cdot 10^{-3}$ M $MgCl_2$ there is a significant difference in T_m, the transition temperature of three transfer RNA's which appears to be correlated with their guanine plus cytosine content: for alanine, tyrosine and valine RNA the values are 73°, 52.5°, and 49.5°, respectively. (auth)

21433 ASCORBIC ACID RETENTION AND COLOR OF STRAWBERRIES AS RELATED TO LOW-LEVEL IRRADIATION AND STORAGE TIME. Claudia E. Wells, Doris A. Tichenor, and Dudley C. Martin (Univ. of Kentucky, Lexington). Food Technol., 17: 77-80(Jan. 1963).

Freshly picked strawberries were irradiated in a gamma source and ascorbic acid (ASA) and its oxidative breakdown products were measured at intervals during 3 to 6 months' storage. Reduced ASA, dehydroascorbic acid (DHA), diketogulonic acid (DKA), and total ASA were determined in unirradiated strawberries and in strawberries receiving 0.3 and 0.8 Mrad. Irradiation caused a significant loss of total ASA. Storage at 35°F for 180 days resulted in further losses, most of which occurred during the first 95 days. Addition of a glucose oxidase packet to atmospheric packs did not affect retention of total ASA. A significant amount of reduced ASA was destroyed by irradiation, the loss being greater at the higher level used. Relatively large amounts of DHA in the samples 2 days after irradiation in the presence of almost complete retention of total ASA indicated that the degradation followed the usual pattern: reduced ASA to DHA to DKA. After 180 days storage, practically all of the reduced ASA was destroyed in air-packed irradiated samples, but comparable glucose-oxidase-packed samples retained 33 to 47% of their original reduced ASA. Measurement of the Gardner a color value revealed a significant loss of redness in irradiated strawberries, and considerable color variability among samples. Color losses were higher at higher doses. (H.H.D.)

21434 ESTIMATION OF FAT ABSORPTION BY MONITORING OF EXPIRED RADIOACTIVE CARBON DIOXIDE AFTER FEEDING A RADIOACTIVE FAT. Arthur D. Schwabe, Frank J. Cozzetto, Leslie R. Bennett, and Sherman M. Mellinkoff (Univ. of California, Los Angeles). Gastroenterology, 42: 285-91(Mar. 1962).

A rapid, quantitative method based upon the oxidative decarboxylation of an easily absorbable, short-chain fatty acid is described. The method for diagnosis of steatorrhea is based upon oral administration of radioactive glyceryl trioctanoate (RATO) and study of its oxidative decarboxylation as determined by monitoring expired $C^{14}O_2$. Results on 20 controls and 21 patients with steatorrhea of various types clearly separated 15 of the controls from all of the patients with steatorrhea, and 14 of 21 patients with steatorrhea fell below the lowest value encountered in 20 control subjects. The test was performed in the fasting patient, who was given a gelatin capsule containing 2 to 3 μC of RATO in a corn oil base, and after 10 min $C^{14}O_2$ in the expired air was measured. By calibration against standard sources the $C^{14}O_2$ is expressed in microcuries of activity. The average delay time is 26 min with a range of 8 to 54 min. The method thus provides a simple indication that gastric emptying has begun. (TCO)

21435 NEW TECHNIQUE FOR LABELING TRIOLEIN BY I^{131} AND Br^{82}. J. A. Berger, G. Meyniel, H. Renault, P. Blanquet, and R. Coudert (Faculté de Médecine et de Pharmacie, Clermont-Ferrand, France). J. Med. Bordeaux Sud-Ouest, 138: 967-78(Aug. 1961).

An improved method, which gives a highly labeled fat for alimentary absorption studies, is described. The method depends upon the reaction of the double bond of oleic acid with 1 molecule of BrI. BrI is prepared by the reaction of NaI^{131} and $Br^{82}NH_4$ in the presence of $KHSO_3$; the reaction is practically complete after the reagents are allowed to stand in aqueous solution at room temperature for 30 min. Labeling is carried out by introducing an ethanol solution of triolein into the mixture, shaking, adding acetic anhydride, and decanting the upper acetic acid phase. The excess BrI is removed by treatment with an aqueous solution of a reducing agent consisting of equal parts (by weight) of KI and $Na_2S_2O_3$. Analysis of the labeled fat showed that 97% of the theoretical amount of BrI had reacted with the unsaturated fatty acid molecules. Besides the high degree of labeling obtained with the method, it avoids the use of organic solvents, which are difficult to remove from the fat and provide a less favorable starting product for human fat absorption studies. Purification of the labeled triolein and its analysis after separation by paper and column chromatography are described. The results showed that less than 1% of the initial radioactivity of Br^{82}-I^{131}-labeled triolein was lost after 3 weeks' storage. The small amount of free radioactivity in the preparations did not interfere with the results of biologic studies. (H.H.D.)

21436 FIXATION AND STAINING: STUDY OF THE AFFINITIES OF NUCLEOPROTEIN CONSTITUENTS FOR LEAD HYDROXIDE AND URANYL ACETATE. V. Marinozzi and A. Gautier (Université, Lausanne, Switzerland). J. Ultrastruct. Res., 7: 436-51(Dec. 1962). (In French)

After the usual OsO_4 fixation, neither uranyl acetate nor Pb hydroxide, used as contrast agents for electron microscopy, stains chromatin in a selective way. After fixation in formalin, chromatin is intensely stained by uranyl acetate but not by Pb hydroxide. On the other hand, if formalin fixation is followed by postfixation treatment with OsO_4 or uranyl acetate, chromatin shows marked affinity for Pb hydroxide while retaining its affinity for uranyl acetate. Hence, OsO_4 and uranyl acetate act as stabilizers of deoxyribonucleoproteins previously fixed by formalin. Formalin acts as an inhibitor, when it is used as a fixative, of the denaturing action of OsO_4 on the nucleoproteins.

Conversely, pretreatment with OsO_4 is capable of preventing changes produced by the dehydration of chromatin during formalin fixation. After formalin-OsO_4 fixation, all nucleoproteins are stained so intensely that they cannot be distinguished by density differences. However, after formalin-uranyl acetate fixation, Pb hydroxide stains chromatin more intensely than nucleolus or ribosome nucleoproteins. Thus deoxyribo- and ribonucleoproteins are distinguishable by this technique. It is postulated that a linkage is formed between chromatin and Pb hydroxide and uranyl acetate. (H.H.D.)

21437 THE INFLUENCE OF METHIONINE SULFOXIMINE ON METABOLISM OF RATS IN COMPARISON WITH RADIATION DISEASE. J. Koloušek, Z. Dienstbier, and Č. Michalec (Charles Univ., Prague). Klin. Wochschr., 39: 393-4(Apr. 1, 1961).

The effect of a single intraperitoneal dose of methionine sulfoximine (MSI) on the incorporation of DL-methionine-S^{35} in rat tissues was studied. MSI stimulated incorporation of S^{35} into proteins in spleen, but in liver S^{35} uptake by protein was diminished and activity in nonprotein fractions was lower than in controls. Excretion of S^{35} in urine was doubled 6 hr after injection of MSI. A single injection of MSI reduced the spleen content of esterified fatty acids, free, and total lipids but no change in cholesterol and phospholipids. Blood showed a rise in neutrophils and a fall in lymphocytes and reticulocytes. In urine a marked rise occurred in the intensity of the Dische reaction for deoxyribose, a change previously noted in radiation disease. X irradiation of rats with 600 r also elevated the urinary excretion of S^{35} after administration of methionine-S^{35}. MSI diminished the incorporation of P^{32} in cytoplasmic ribonucleic acid ~59%. It is suggested that MSI and radiation have analogous modes of actions. (H.H.D.)

21438 METABOLIC BALANCE AND Sr^{85} STUDY OF A PATIENT WITH MULTIPLE MYELOMA TREATED WITH CORTICOSTEROIDS AND ANDROGENS. William A. Skoog, William S. Adams, and Norman S. MacDonald (Univ. of California, Los Angeles). Metab., Clin. Exptl., 11: 421-34(Apr. 1962).

A long-term metabolic balance investigation in a 40-yr-old man was undertaken to evaluate the efficacy or inefficacy of combined corticoid-androgen therapy in a single patient. After a suitable control period the patient was given prednisone alone, then prednisone plus testosterone propionate and finally ACTH plus testosterone propionate. Sr^{85} excretion studies were done in conjunction with the metabolic tests to assist in interpretation of Ca metabolism. Clinically, diminution of bone pain, increase in physical activity, rise in hematocrit, and loss of weight were effected by prednisone alone. Combined therapy with testosterone reversed the weight loss and further increased hematocrit levels. Bone pain remained diminished. The ACTH-testosterone combination, however, appeared to be superior in that physical activity rose above that with the other 2 treatments. Negative Ca balances were observed throughout the study. Further lessening of negative Ca balance was seen with the ACTH-testosterone combination. Sr^{85} tests showed that there was considerable reduction in the daily loss of bone mineral with the addition of testosterone therapy to either prednisone or ACTH. The findings are in accord with the observed reduction in magnitude of the negative Ca balance. Comparisons of total excretion of Sr^{85} also show that the greatest reduction in loss of bone mineral occurred with the combination of ACTH and testosterone, 66% of the total intravenous dose of Sr^{85} being excreted within 15 days compared with 84% during prednisone or 73% during prednisone and testosterone treatment. (H.H.D.)

21439 METHOD FOR THE DETERMINATION OF Sr^{90} APPLICABLE BOTH TO ASH AND FRESH MILK SAMPLES. G. G. Calapaj and D. Ongaro (Università, Padua). Minerva Nucl., 7: 36-43(Jan.-Feb. 1963). (In Italian)

A critical analysis of methods for assaying Sr^{90} in milk showed that the presence of phosphoric and sulfuric anions in milk ash represents a significant cause of error. A method based on the separation of cations from anions by means of ion exchange resins is proposed to obviate these drawbacks. This technique, although it follows the general pattern of the classical methods for the separation of Sr^{90} from Y^{90}, differs from them in the initial stages. As well as improving the entire analytic process, it has the advantage of being directly applicable to fresh milk. The process consists of placing the milk in a container together with Kastel C 300 cation exchange resin in the H form, mixing, and then eluting the resin in a column with hydrochloric acid. This method is especially suitable for routine determinations. (auth)

21440 IN VIVO MEASUREMENT OF IODINE-131 IN THE THYROID OF THE DAIRY COW AS AN AID FOR MONITORING MILK. Noboru Yamagata and Kiyoshi Iwashima (Inst. of Public Health, Tokyo). Nature, 198: 169-70(Apr. 13, 1963).

In vivo measurements of I^{131} in the thyroid of dairy cows were carried out using a scintillation rate meter with the receptor in direct contact with the skin. The measurements were made immediately prior to slaughter and results were compared with measurements of the actual I^{131} content of the thyroid glands. The relation between thyroid radioactivity measured in vivo and the I^{131} level in milk excreted by the same animal was determined in another series of measurements. Results indicate that rough estimates of the I^{131} levels in milk can be obtained by in vivo measurement of thyroid radioactivity. The degree of free grazing was found to significantly affect the levels of I^{131} in the thyroid glands of dairy cattle. (C.H.)

21441 ACCUMULATION OF CALCIUM AND STRONTIUM BY BROWN TROUT FROM WATERS IN THE UNITED KINGDOM. W. L. Templeton and V. M. Brown (United Kingdom Atomic Energy Authority, Windscale Works, Cumberland, Eng.). Nature, 198: 198-200(Apr. 13, 1963).

Data on the accumulation of stable Ca and Sr in bone and muscle of brown trout, Salmo trutta, taken from various waters in the United Kingdom were analyzed for the relation between Ca and Sr and concentrations in water. (C.H.)

21442 UPTAKE OF IODINE-131 BY THYROIDS OF RATS DURING HEALING OF FRACTURES. F. A. Soliman, A. H. Said, M. K. Soliman, and M. S. Abdo (Faculty of Veterinary Medicine, Giza, Egypt). Nature, 198: 203(Apr. 13, 1963).

The uptake of I^{131} by thyroids of rats during the healing of fractures was found to reach a maximum two weeks post-fracture and then decline until the normal level was reached at the end of the 4th week. It was concluded that under normal conditions there is an increased activity of thyroid gland during the stage of cellular regeneration of callus formation, after which it drops to normal values. (C.H.)

21443 RADIUM-226 IN BONE AND SOFT TISSUES OF MAN. John B. Hursh and Arvin Lovaas (Univ. of Rochester, N. Y.). Nature, 198: 265-8(Apr. 20, 1963).

Levels of Ra^{226} in man due to natural environmental radioactivity were measured in pooled samples of bone and soft tissues from autopsy material. The findings indicate that about 80% of the body burden of Ra in man is contained in the skeleton. Chemical and counting procedures are described. (C.H.)

21444 RADIONUCLIDES IN AMERICAN DIETS. Nutrition Revs., 21: 105-6(Apr. 1963).

American diets in 25 cities were analyzed during 1961 and 1962 for their content of 8 radionuclides and stable Ca and K. Data are presented on the diets of infants, teenagers, and adults. (C.H.)

21445 WATER AND ELECTROLYTE BALANCE STUDIED BY RADIOISOTOPES. II. THE EXCHANGE OF SODIUM (Na^{22}) AND RUBIDIUM (Rb^{86}) IN A PATIENT WITH BONE METASTASES FROM MAMMARY CARCINOMA TREATED WITH COBALT THERAPY. F. Di Pietrantonj, M. Sanguineti, and G. Repossi (Università, Palermo, Italy). Pathologica, 54: 205-8(July-Aug. 1962).

Studies were conducted in a patient with metastatic cancer who received Co^{60} radiotherapy, consisting of a total of 6440 r over 7 weeks to the lumbar vertebrae and 3000 r over 2 weeks to the pituitary. To investigate electrolyte exchange postirradiation, the patient was injected with 25 μC Na^{22} and 1000 μC Rb^{86}, and excretion of the isotopes in urine and feces was followed. The half-time values for Na^{22} were 15.5 days for urinary excretion, 12.5 days for tissue radioactivity, and 8 days for plasma radioactivity. The half-time values for Rb^{86} were 45 days for fecal and urinary excretion and 6.8 days for plasma disappearance. Na exchange could be represented mathematically by the expression: $A_t = A_0e^{-(0.045+0.025)t}$, where A_t and A_0 signify body radioactivity at time (t) and time (0). The corresponding expression for K (Rb) was: $A_t = A_0e^{-(0.086+0.018)t}$. Urinary excretion of Na^{22} was diminished following irradiation, while Rb^{86} excretion was unchanged. (H.H.D.)

21446 RADIONUCLIDE MINERAL STUDIES. 2. THE EFFECT OF CERTAIN DIETARY CONSTITUENTS, INCLUDING PROTEIN AND VITAMIN B_{12} ON THE METABOLISM OF INORGANIC S^{35}-SULFATE IN THE CHICKS. W. G. Martin and H. Patrick (Univ. of West Virginia, Morgantown). Poultry Sci., 39: 1501-10(Nov. 1960).

Attempts were made to ascertain the factor or factors in the natural feedstuffs diet, which, in the presence of vitamin B_{12}, decrease the retention of S^{35} by chick skeletal tissue 24 hr after administration. Also studied was the rate of S^{35} uptake by various tissues of the chick as influenced by vitamin B_{12}. When given with vitamin B_{12}, as a dietary supplement or administered at the time of S^{35} administration, dietary protein was found to influence uptake of S^{35}. Soybean oil meal, normally used in practical chick diets, gives the largest response. When soybean oil meal was compared to casein and Drackett, the higher response to S^{35} uptake by the chick skeletal tissue was in the casein dietary group. The S^{35} retention with the casein group, containing the highest level of sulfur amino acids, tends to minimize the body dilution theory in favor of the biological value of the protein and a possible sparing effect in relation to methionine and cysteine for protein or other synthesis. The results indicate increased retention of S^{35} with increased vitamin B_{12} levels, possibly through the sulfate-fixing enzyme system. (TCO)

21447 RADIONUCLIDE MINERAL STUDIES. 3. THE EFFECT OF BREED AND DIETARY ZINC, CALCIUM, AND VITAMIN D_3 ON THE RETENTION OF $ZINC^{65}$ IN CHICKS. W. G. Martin and H. Patrick (Univ. of West Virginia, Morgantown). Poultry Sci., 40: 1004-9(July 1961).

Chicks were fed soybean protein–cerelose basal ration containing a tricalcium phosphate–calcium carbonate mineral mixture. Growth and general appearance were improved by the supplementation of Zn up to 30 ppm, and bone abnormalities and skin lesions were abolished by supplementation of 40 to 60 ppm of Zn. Breed differences were observed. The overall retention of Zn^{65} in the tibia was higher in the New Hampshire and New Hampshire × White Leghorn chicks than in White Leghorn and White Leghorn × New Hampshire chicks at 21 days of age. Liver Zn^{65} uptake was decreased steadily by increasing dietary Zn supplementation, tending to level off after 30 ppm added Zn. Addition of vitamin D_3 to the D_3-deficient basal diet decreased liver Zn^{65} uptake regardless of dietary Zn or Ca level. The presence of vitamin D_3 increased the Zn^{65} content of the tibia when the diet contained 1.0% Ca, and decreased it in the presence of 1.6% Ca in both the Zn-adequate and deficient groups. Excess Ca in the intestine may effect the precipitation or removal of Zn via the feces since Ca source, level, and pH were shown to influence the removal of Zn^{65} from solution in vitro. Ca^{45} mineralization of the tibia was increased by vitamin D_3 addition, and decreased by increasing the dietary Ca level. (H.H.D.)

21448 EFFECT OF VARYING LEVELS OF TAPAZOLE ON THYROIDAL-I^{131} UPTAKE IN NEW HAMPSHIRE PULLETS. Perry Stahl, G. W. Pipes, and C. W. Turner (Univ. of Missouri, Columbia). Poultry Sci., 40: 1479-83(Nov. 1961).

A study was conducted to determine the minimum quantity of tapazole that would partially or completely prevent the uptake of I^{131}. Some degree of inhibition of I^{131} uptake by the thyroid was noticed at all levels of tapazole administration. At levels of 0.025% or 0.0375%, between 40 and 50% reduction of I^{131} (after a 10 μC dose) uptake was noted after 2 days. Uptake was reduced about 40% more after 5 days tapazole administration in those birds whose thyroids were not completely blocked. However, the levels of tapazole were inadequate to block completely I^{131} uptake within a practical period of time to prevent thyroidal-I^{131} recycling. The level of 0.05% tapazole in the feed produced an almost immediate and complete blocking effect on 80% of the birds. Although the lower levels of tapazole feeding did not completely block I^{131} uptake, the levels did show some deleterious effects on the birds, and egg production was reduced $\frac{1}{3}$. (TCO)

21449 RADIONUCLIDE MINERAL STUDIES. 4. STUDIES ON THE METABOLISM OF Ca^{45} BY THE CHICK. W. G. Martin and H. Patrick (Univ. of West Virginia, Morgantown). Poultry Sci., 41: 213-9(Jan. 1962).

Different breeds of chicks, owing in part to rates of metabolism and growth, showed different Ca^{45} mineralization of the tibia. White Leghorn chicks contained a higher Ca^{45} mineralization after 24 hr than did the New Hampshire birds, and New Hampshire × White Leghorn chicks had the least. The presence of amino acids in the Ca^{45} dose appeared to influence the uptake and retention of the isotope, and methionine was associated with increased Ca^{45} maximum retention. A peptide, serylglutamic acid, decreased mineralization of Ca^{45}. The presence of taurine in the ration, however, markedly reduced the rate of uptake of Ca^{45} into blood and tibial tissue. The results suggest that the absorption and subsequent retention of Ca by tissues may be influenced by the presence of compounds that act as complexers and possess the ability to effect an increased concentration of Ca ions. (TCO)

21450 RADIONUCLIDE MINERAL STUDIES. 5. THE RELATION OF SERUM ALKALINE PHOSPHATASE TO Ca^{45} METABOLISM IN THE CHICK AS INFLUENCED BY AGE, VITAMIN D_3, AND TREATMENT. W. G. Martin and H. Patrick (Univ. of West Virginia, Morgantown). Poultry Sci., 41: 916-21(May 1962).

The relation of serum alkaline phosphatase to Ca^{45} metabolism in the chick was studied, as well as the influence

of age, vitamin D_3, and dosing procedure on the relation. In White Leghorn chicks the absence of dietary vitamin D_3 was associated initially with higher enzyme activity, lower Ca^{45} mineralization, and tibia ash content. After 2 weeks of age, however, a trend suggesting correction of the deficiency was observed until 3 weeks of age. Serum alkaline phosphatase activity increased subsequent to the oral administration of water to the chick. The effect does not manifest itself early in life, and was not observed until the chicks were ~1 week of age. Previously injected Ca^{45} was removed from bone into the blood of chicks subsequent to giving distilled H_2O. This was indicated by decreased bone Ca^{45}, increased total serum Ca, and serum Ca^{45} and was paralleled by increased serum alkaline phosphatase activity. The variability of serum alkaline phosphatase activity in the chick may be due to its apparent role in serum Ca homeostasis. Any factor lowering the serum Ca level appeared to initiate bone resorption, which may be triggered by parathyroid hormone. Any factor leading to decalcification induces and may depend upon increased production of alkaline phosphatase. (H.H.D.)

21451 ON THE OCCURRENCE OF STRONTIUM IN THE EGG AFTER FEEDING TO HENS. I. DEPOSITION IN THE YOLK. K. Zipf, A. Schmid, and J. Gropp (Universität, Munich). Z. Ernaehrungswiss., 3: 27-32(1962).

One-yr-old White Leghorn hens were fed for 180 days a diet containing 2 meq $SrCO_3$ per 100 g dry wt. The Sr : Ca ratio of the diet was ~1 : 22. The yolks of eggs laid subsequently were ashed and their Sr and Ca content determined. Sr first appeared in the yolks on the 4th day after Sr was fed, at a level of 0.09% of the ash. Sr content of the yolks then rose sharply and in 2 to 3 weeks reached an average value of 0.5% of the ashed yolk, compared with an average Ca level of 7.5%. When $SrCO_3$ was discontinued from the diet, the yolk ash Sr content fell to 0.2% 27 days later and to 0.06% 186 days later. No Sr was detectable in the yolks 427 days later, and the Ca content at this time was ~7.6%. The maximum Sr : Ca ratio reached during Sr feeding was 1 : 15. The Sr content of the bones of hens fed Sr for 47 days was 0.33% of the ash for tibia and 0.37% for vertebra. The corresponding values after 180 days of Sr feeding were 0.50 and 0.58% and 427 days after removal of Sr from the diet were 0.14 and 0.16%. (H.H.D.)

21452 ON THE OCCURRENCE OF STRONTIUM IN THE EGG AFTER FEEDING TO HENS. II. DEPOSITION IN THE SHELL. K. Zipf, A. Schmid, and U. Fritz (Universität, Munich). Z. Ernaehrungswiss., 3: 33-40(1962).

White Leghorn hens at the age of 1 yr were placed on a diet containing 2 meq $SrCO_3$ per 100 g dry wt. The diet, which was fed ad libitum for 180 days, had a Ca : Sr ratio of 22. At the end of this time, $SrCO_3$ was replaced with an equivalent amount of $CaCO_3$ and feeding was continued for 218 days. Sr and Ca contents were determined in the ashed shell of 200 eggs laid during this period. Sr appeared in the shell of eggs laid the same day Sr feeding was begun. The ash of the shells contained 0.6% Sr and 72% Ca. Sr content then continuously increased to reach a maximum value of 2.6% of the ashed shell by the 57th day of Sr feeding, at which time the Ca content was ~68%. The decline in Ca content is significant and represents a replacement of Ca by Sr in shell mineral. At the maximum Sr level in the shell (the saturating concentration) the Ca : Sr ratio reached 26, compared with the dietary ratio of 22. After removal of $SrCO_3$ from the diet the shell Sr level fell rapidly; 143 days later it reached 0.1% of the ash and was no longer detectable after 175 days. (H.H.D.)

21453 RAPID METHODS FOR ESTIMATING FISSION PRODUCT CONCENTRATIONS IN MILK. [Bernd Kahn, ed.] (Public Health Service, Washington, D. C.). Public Health Service Publication No. 999-R-2. Mar. 1963. 30p. (Free from USPHS)

Rapid methods are described for identifying and measuring iodine-131, strontium-89, and strontium-90 in milk by chemical separation combined with counting. The use of multichannel gamma spectroscopy is outlined for determining the gamma-emitting radionuclides cesium-137, iodine-131, and barium-140 in milk. The method for iodine-131 yields determinations within 2 to 3 hours, and is designed to measure concentrations of 100 $\mu\mu c/l$. The radiostrontium procedure permits analyses of several samples simultaneously in about 5 hours. Recovery in tracer studies was found to be 80 ± 5%. The gamma spectroscopy determination is estimated to have accuracy of ±5 – 10 $\mu\mu c/l$ between 0 and 100 $\mu\mu c/l$, and ±5 – 10% at higher concentrations. (auth)

21454 RAPID DETERMINATION OF IODINE-131 IN MILK. G. K. Murthy (Robert A. Taft Sanitary Engineering Center, Cincinnati). p.7-10 of "Rapid Methods for Estimating Fission Product Concentrations in Milk." Washington, D. C., Public Health Service, 1963.

Iodine-131 in market milk is mostly in the inorganic form as the iodide, very little being bound by proteins. Of the several fission products formed from nuclear weapons tests or reactor accidents, iodine-131 is the only anionic radionuclide present in milk. Therefore, it is possible to absorb iodine-131 on anion exchange resins and determine its activity by gamma counting without interference from other radionuclides, unless formaldehyde has been added or prior cation-exchange resin treatment has been used. Iodine-131 gamma activity is easily measured with a shielded 2" NaI(Tl) crystal with photomultiplier assembly fed through a cathode follower and connected directly to a decade scaler. If a single-channel spectrometer is available, the detector background-to-efficiency ratio may be reduced appreciably by counting only the 364 Kev photoelectric peak. (auth)

21455 RAPID DETERMINATION OF STRONTIUM-89 AND STRONTIUM-90 IN MILK. Charles Porter (Southeastern Radiological Health Lab., Montgomery, Ala.). p.11-15 of "Rapid Methods for Estimating Fission Product Concentrations in Milk." Washington, D. C., Public Health Service, 1963.

Procedures are described for the measurement of total radiostrontium in milk based on the essentially complete absorption of strontium on cation exchange resin. After collecting strontium and other cations on the resin column, they are eluted with sodium chloride solution. Strontium and barium carriers that were added and other insoluble carbonates are precipitated to separate the strontium from cesium-137 and potassium-40. The precipitate is dissolved and strontium nitrate is precipitated with fuming nitric acid. After dissolving it in water, a barium chromate precipitation at pH 5 removes barium-140. Strontium, together with very little calcium, is reprecipitated with fuming nitric acid. The nitrates are dissolved in water, transferred to a steel planchet, and dried. The sample is measured in a beta counter, and the sample is covered with a thin aluminum foil and recounted to differentiate between strontium-89 and strontium-90. (auth)

21456 DETERMINATION OF IODINE-131, CESIUM-137, AND BARIUM-140 IN MILK BY GAMMA SPECTROSCOPY. G. Richard Hagee, Gerald J. Karches, and Abraham S. Goldin (Robert A. Taft Sanitary Engineering Center,

Cincinnati). p.17-26 of "Rapid Methods for Estimating Fission Product Concentrations in Milk." Washington, D. C., Public Health Service, 1963.

Applications of γ spectroscopy for the simultaneous measurement of Cs^{137}, I^{131}, and Ba^{140} in milk are discussed. It is pointed out that this is a convenient technique for the simultaneous measurement of these γ-emitting nuclides. (C.H.)

Fallout and Ecology

Refer also to abstracts 21938 and 21950.

21457 (SCPRI(RM)I-63) RAPPORT D'ACTIVITE, JANVIER 1963. (Report of Activities, January 1963). (France. Service Central de Protection contre les Rayonnements Ionisants, Paris). 52p.

The results of the radiological monitoring of the atmosphere, nuclear sites, rain waters, and the food chain are summarized and shown graphically. (J.S.R.)

21458 RADIOACTIVE FALLOUT IN JASSY IN 1960. V. Mageru and D. Blănariu (Section of Physics Research, Jassy). Acad. Rep. Populare Romine, Filiala Iasi, Studii Cercetari Stiint., Fiz. Stiinte Tehn., 12: 15-21(1961). (In Rumanian)

In a continuation of the measurements made in Jassy starting in 1958 on the artificial activity of the atmosphere, the results of these measurements for 1960 are reported. The method used includes the collection of daily samples in polyethylene pots with water, evaporation to dryness, calcination of the solid residues, and measurement of the β activity. Several activity peaks caused by the French nuclear explosions in the Sahara and a general rise of long-lived fission products in the spring and summer months were observed. By the end of the year the artificial activity of the atmosphere had decreased to a mean level of 20 to 30 $\mu\mu C/m^2$. The external gamma dose to the population was calculated on the basis of the daily activity levels. From January 1, 1959, to December 31, 1960, the total dose was 14 mr/30 years. (auth)

21459 THREE YEARS OF SYSTEMATIC MEASUREMENTS OF FALLOUT AT JASSY. Victor Mageru and Dragoş Blănariu (Inst. of Chemistry and Physics, Jassy). Acad. Rep. Populare Romine, Filiala Iasi, Studii Cercetari Stiint., Fiz. Stiinte Tehn., 13: 17-31(1962). (In Rumanian)

The results of daily measurements on the fallout at Jassy between September 1, 1958, and September 1, 1961, are reported. After a description of the methods used (collecting, preparation, and measurement of the samples), the results are given in the form of histograms and explained. Three or four French nuclear experiments in 1960 caused sharp activity maxima at Jassy. The mean and monthly specific activity of rain water reflected the variation of the contamination of the lower troposphere. After each new injection of radioactive materials, the concentration decreased with an effective decay period of 45 days. For the determination of the isotopic composition of fallout samples, radiochemical analysis and radiation absorption of aluminum were used. In all the absorption curves, three distinct components could be distinguished: a hard component (2.5 Mev), a mean component (1.16 Mev), and a soft component (0.39 Mev). A comparison was made between experimental and theoretical data, and an attempt was made to explain the surplus of soft radiations found in the winter samples of 1958-59. It was found that in the old fallout samples, particles with very small diameter predominate, whereas in recent depositions large particles 5 to 8 mm appear. After three years of measuring the fallout accumulations at Jassy, a value of 42.5 mC/km^2 was attained. The Sr^{90} concentration in rain water shows a sharp seasonal variation each year because of the exchange of air masses between the stratosphere and the troposphere. The soil deposition of Sr^{90} occurred at a rate between 0.03 and 0.69 mC/km^2 per month, and its value has reached 6.7 mC/km^2. The external irradiation dose given by the fallout was evaluated as 20.2 mr/generation. (tr-auth)

21460 THE DISTRIBUTION OF RADIOYTTRIUM IN ORGANS OF THE WHITE MICE AFTER INHALATION OF Y^{91} LIQUID AEROSOLS. F. Gensicke, H. W. Nitschke, and E. Spode (Institute Medizin und Biologie, Deutsche Akademie der Wissenschaften und Robert-Rossle-Klinik, Berlin-Buch). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 98: 338-41(Mar. 1963). (In German)

The absorption and distribution of inhaled $Y^{91}Cl_3$ in white mice are considered. Compared with Ce^{144}, Y^{91} is eliminated much more quickly from the lungs. After 30 minutes inhalation, only 28.29% of activity was found in the lungs, as compared with 25.09% in the gastrointestinal tract. Y^{91} is stored in the skeleton following inhalation; skeletal values exceed activity in the lungs after an interval of 30 days. The values observed in other organs were considerably less. (auth)

21461 RADIOACTIVE FALLOUT. Elmer W. Campbell (Dept. of Health and Welfare, Augusta, Maine). J. Maine Med. Assoc., 53: 22-4(Jan. 1962).

The composition of fallout and methods for its detection are discussed, and the current program for sampling fallout in Maine is described with some results reported. Since the testing program began in September, 1961, readings have jumped from a low of ~0.1 $\mu\mu C/m^3$ to a maximum of 71.2, which is the highest reading yet recorded in the area. This, compared with a 4-day reading, when it dropped to 37.5, indicated how quickly the radioactivity decreases. The fluctuations, however, from day to day have been measurable, and have been consistent with those found in Massachusetts. There appears to be about the same amount of radioactivity in Augusta, for instance, as at Lawrence, Massachusetts, where extensive studies of atmospheric radioactivity are being made. However, the amount of activity is quite different from that in Connecticut and further south, since readings of 400 to 500 $\mu\mu C/m^3$ were recorded in the middle states, around Arkansas and in that general vicinity down through Tennessee and South Carolina, following Hurricane Carla, which apparently sucked in polar air with its attendant radioactive debris and permitted such debris to be deposited. (TCO)

21462 METHODS FOR CONCURRENT SAMPLING AND MONITORING OF AIRBORNE RADIOACTIVITY AT VARYING RADON AND THORON LEVELS IN LABORATORIES. R. Ehret, H. Kiefer, and R. Maushart (Kernforschungszentrums, Karlsruhe, Ger.). Kerntechnik, 5: 97-103(Mar. 1963). (In German)

Many methods are currently used to reduce the influence of radon and thoron variations when measuring airborne radioactivity in laboratories. A description and a discussion of such methods are given together with some suggestions, including a differential method for general activity survey using γ discrimination against the natural radioactivity, and an α-x-ray coincidence method for monitoring

Pu^{239} that is virtually insensitive to γ background and to any other radioactivity in the air. (auth)

21463 PROBLEMS IN THE SUPERVISION OF SEA WATER FOR RADIOACTIVE CONTAMINATION. J. Joseph (Deutsche Hydrographische Institut, Hamburg). Kerntechnik, 5: 108-10(Mar. 1963). (In German)

The question of monitoring sea water for radioactive contamination also includes the purely oceanographic question of the distribution of suspensions in the sea with respect to space and time. Three examples are presented to demonstrate the variety of manners in which mixing processes proceed in the sea. One statistical method suitable for a limited prediction of dispersion processes was tested on a large scale in the ocean using radioactive material. (auth)

21464 PROBLEMS OF CONTROLLING SEA WATER FOR RADIOACTIVE ADDITIONS. H. Kautsky (Deutsche Hydrographische Institut, Hamburg). Kerntechnik, 5: 110-13(Mar. 1963). (In German)

The contents of a lecture given in spring 1962 to the Study Association for the Promotion of the Use of Nuclear Energy in Shipbuilding and Navigation are presented. A general survey is given on the origin and the problems of detecting radioactive fission products in sea water. In this connection, details on the applied procedures and on the measurements of activities in sea water and sea bed obtained with these methods are given. (auth)

21465 MODEL EXPERIMENT IN THE LABORATORY OF THE WASH-OUT EFFECT FOR RADIOIODINE. Margrit Lesigang and F. Hecht (Universität, Vienna). Mikrochim. Ichnoanal. Acta, No. 1, 32-9(1963). (In German)

The wash-out effect in the case of radioactive iodine was studied by means of a "rain apparatus" developed in the laboratory. This device reproduces on a laboratory scale a natural rain shower. A comparative study was made of the relation of the degree of dispersion of the sprayed-in solution, of the depth of the rainfall, and temperature with regard to free iodine and iodide anion. I^{131} was used in the form of iodine and iodide both carrier-free and with added carrier. (auth)

Radiation Effects on Living Tissues

Refer also to abstracts 22690 and 22692.

21466 (HW-SA-2280) EFFECTS OF X-IRRADIATION ON THE PERMEABILITY OF YEAST. R. T. O'Brien and F. P. Hungate (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1961]. Contract AT(45-1)-1350. 19p.

Following x-irradiation yeast cells show a decrease in the ability to retain potassium, phosphate, and 260 mμ absorbing materials. The leakage rates for potassium and phosphate increased exponentially with dose, whereas, a threshold response was obtained for leakage of 260 mμ absorbing materials. Active uptake of phosphate and potassium was not affected by doses up to 240 kr. Irradiated cells were found to be more permeable to extracellular water and phosphate under conditions which precluded active incorporation. It is suggested that decreased retentive capacity after x irradiation is primarily due to damage to the permeability barrier of the cell membrane. A possible mechanism of damage to the cell mambrane through interaction of the x rays with essential membrane SH groups is discussed. (auth)

21467 (TID-18549) THE INFLUENCE OF PRE- AND POSTNATAL LOW INTENSITY CHRONIC RADIATION ON THE STRUCTURE AND FUNCTION OF THE GERMINAL EPITHELIUM IN THE ALBINO MOUSE. Final Report. Sidney O. Brown (Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station and Texas. Agricultural and Mechanical Coll., College Station. Research Foundation). Apr. 1, 1963. Contract AT(40-1)-2597. 46p.

Swiss albino mice were chronically exposed to Cs^{137} γ rays at the rates of 2, 5, 10, and 20 r/23-hr day in utero from the first day of gestation, and remained in the radiation field for various lengths of time postnatally until they were taken out of the radiation chamber and either bred to untreated mates or sacrificed for histological studies. Irradiation at 2 r/d, showed no demonstrable effect on testis weight, tubular diameter, and cellularity of the tubules after a dose of 306 r (153 days). Cell number of the tubule decreased to one-half of normal after 380 r (at 5 r/d for 76 days); and to one-fourth of normal after 830 r (at 10 r/d for 83 days). There was a slight effect on tubular diameter after 62 days of irradiation at 5 r/d (310 r). The effects of the same duration of irradiation at 10 and 20 r/d were more drastic. The data suggest that males were fertile, with spermatozoa production one-fourth as much as that of normal males. The fertility and litter size of the females were more easily affected than those of the males. The effects of irradiation of males and females on reproduction are summarized. (C.H.)

21468 (USNRDL-TR-628) DIFFERENTIAL RESPONSE TO ALLOGENIC AND XENOGENIC SKIN GRAFTS BY SUBLETHALLY IRRADIATED (670 rad) AND NON-IRRADIATED MICE SENSITIZED BY VARIOUS MEANS. M. L. Tyan and L. J. Cole (Naval Radiological Defense Lab., San Francisco). Mar. 11, 1963. 26p. (AD-402294)

Twelve to 14 week old female LAF_1 mice were presensitized either with 3 i.p. injections of BALB/c or rat spleen or skin cells, or by means of two consecutive BALB/c or rat skin tail grafts. One week following the last injection or the rejection of the second skin graft, the mice either were grafted with LAF_1, BALB/c, C3D/2 and rat skin or they received 670 rad whole body x radiation and were grafted immediately thereafter. The data indicate that skin grafts induce a more vigorous and more radioresistant second-set response than do dissociated cells. Pre-sensitization with allogenic spleen cells resulted in prolonged survival of subsequent allogenic skin grafts in sublethally irradiated mice. The second-set response to a xenogenic skin graft was found to be more radioresistant than was that to an allogenic graft. The converse was true with regard to the first-set response. (auth)

21469 (JPRS-18938) AVERAGE DIAMETER OF ERYTHROCYTES DURING CHRONIC ACTION OF SMALL DOSES OF IONIZING RADIATION ON THE HUMAN ORGANISM. E. (Ye.) D. Gol'dberg. Translated from Lab. Delo, No. 2, 9-11(1963). 4p. (OTS-63-21696)

The average diameter of erythrocytes was measured in blood samples from 252 people who had worked with various medical radiation sources for periods of time varying from 2 to over 20 years. Radiation dosages were calculated to be between 0.02 and 0.04 r daily. X-ray workers did not manifest any significant changes from the norm in average erythrocyte diameter even after 15 years exposure. People working with Ra showed an increase in the average volume of erythrocytes after exposures of less than 5 years. (C.H.)

21470 EFFECT OF THE TREATMENT WITH P-32 ON BLOOD COAGULATION FACTORS IN POLYCYTHEMIA VERA. M. Austoni, I. Masetto, M. Buttò, and V. Crepaldi (Università, Padua). Acta Isotopica, 1: 137-50(1961). (In Italian)

Blood coagulation factors were investigated in 14 patients with polycythemia vera, before and after P^{32} treatment. In connection with the improvement of clinical signs of thrombosis or hemorrhage and with the red cell count decrease, significant changes were observed, especially in the platelet sector. A general normalization of the platelet function occurred with a decrease from 420000 before to 186200/cmm after the therapy. This was evident with the Heparin tolerance test in vitro: the mean values, which were 6'39"/3 heparin Units/ml, 8'57"/7 heparin U/ml, and 12'31"/10 heparin U/ml before treatment, passed to 7'36", 11'10", and 16'08", in connection with the improvement of the plasmatic thrombogenic diathesis. (P.C.H.)

21471 THYROID ANTIBODIES IN PATIENTS SUBJECTED TO TREATMENT WITH RADIOACTIVE IODINE. G. Andolfatto-Zaglia and D. Ziliotto (Università, Padua). Acta Isotopica, 1: 173-90(1961). (In Italian)

Thyroid antibodies were studied, using the agar gel precipitation test and the tanned red cell agglutination test, in thyrotoxic patients treated with radioactive iodine. In 20 patients, who were examined during the weeks following the therapy, thyroprecipitins were never found. Instead, thyroagglutinins were seen in 11 cases. The reaction occurred always some weeks after the administration of radioiodine and usually ceased in a few weeks; the antibody titers were usually low (1:500 to 1:1000), except in one patient who became hypothyroid (1:16.000). Twenty-four patients were examined 3 months to 4 years after therapy. Thyroagglutinins at a high titer (1:8.000 to 1:32.000) and thyroprecipitins were observed only in the 4 patients who, following the administration of radioiodine, became hypothyroid. The results show that radioactive iodine often causes an autoimmune reaction against the thyroid. The reaction is usually weak and of brief duration. Strong and prolonged reactions seem to be observed only in cases in which therapeutic hypothyroidism occurs. It is suggested that the occurrence of antibodies at high titers during radioiodine therapy could indicate the beginning of hypothyroidism. (P.C.H.)

21472 STUDIES ON THE BIOLOGICAL EFFECTS OF SMALL DOSES OF IONIZING RADIATION. I. EFFECTS OF CONTINUED IRRADIATION WITH SMALL DOSES OF Co^{60} GAMMA RAYS ON SPERMATOGENESIS IN MICE. Tadeusz Rudnicki. Acta Physiol. Polon., 14: 69-80(Jan.-Feb. 1963). (In Polish)

Continued 18-month irradiation of male mice with Co^{60} gamma rays in daily doses of 0.17 r caused distinct quantitative, and after 12 months of irradiation also qualitative, changes in the spermatogenic cycle. Injury was manifest in the smaller number of cells participating in the spermatogenic cycle, which was 5 to 12% below the normal level, and in abnormal mitotic and meiotic figures. (auth)

21473 STUDIES ON THE BIOLOGICAL EFFECTS OF SMALL DOSES OF IONIZING RADIATION. II. CHANGES IN THE OVARIES OF MICE IN THE COURSE OF CONTINUED IRRADIATION WITH Co^{60} GAMMA RAYS IN SMALL DOSES. Tadeusz Rudnicki. Acta Physiol. Polon., 14: 81-9(Jan.-Feb. 1963). (In Polish)

Continued irradiation of female mice with Co^{60} gamma rays in daily doses of 0.17 r gave rise to histologically ascertainable changes in the ovaries after as little as two months of exposure. The changes were of the kind typical of aging and developed in the experiments some 5 to 6 months earlier than in unirradiated animals. (auth)

21474 LEUCOCYTE MIGRATION IN PARTIAL BODY IRRADIATION OF GUINEA PIGS. B. Tribukait, A. Forssberg, and Christina Oesterdahl (Karolinska Institutet, Stockholm). Acta Radiol., 1: 49-56(Feb. 1963). (In English)

The concentration of segmented neutrophils and lymphocytes in the blood four hours after partial-body x irradiation in guinea pigs was found to differ markedly from that following a whole-body dose. The significance of the high release of segmented cells into the blood that occurred when a small field over the right side of the abdomen was irradiated, as compared to the release of lymphocytes that was observed after a similar left-sided irradiation, is discussed. (auth)

21475 ACUTE RADIONECROSIS OF THE FINGERS: SURGICAL TREATMENT. F. Lagrot, E. Lavergne, and H. Bensoussan. Algerie Med., 66: 645(June 1962).

A case of radiodermatitis resulting from occupational exposure of both hands to x rays is described. Amputation of the fingers and plastic surgery were required; skin grafting techniques used to repair nonhealing portions of the hand are also described. (H.H.D.)

21476 THE EFFECTS OF FRACTIONATED DOSES OF X RAYS ON THE MAJOR CORONARY ARTERIES OF HYPERCHOLESTEREMIC RABBITS. G. D. Amromin, H. L. Gildenhorn, and R. D. Solomon. Am. J. Clin. Pathol., 39: 298-9(Mar. 1963).

The consequence of preconditioning blood vessels to x rays was tested in coronary arteries of rabbits by means of administering a high cholesterol diet for 2 months prior to irradiation. Young rabbits were fed a high cholesterol diet with corn oil, and 2500 rads were then administered to the precordium, in doses of 500 rads each week for 5 weeks. Animals were killed at intervals from 1 to 20 weeks after completion of therapy, and the hearts of the animals were compared with those of rabbits fed: a normal diet, without x rays; a hypercholesteremic diet, without x rays; and a normal diet, with x rays. In contrast to those in the latter 3 groups, there were pronounced changes in the major coronary arteries of the hypercholesteremic rabbits that were also treated with fractionated doses of x rays. Hence hypercholesteremia and x rays seem to have a synergistic effect on the coronary arteries of rabbits that results in advanced degrees of arteriosclerosis. (TCO)

21477 ENZYME CYTOCHEMISTRY OF I^{131}-IRRADIATED THYROID GLAND. Harold John Sobel, Luis Biempica, and Alex B. Novikoff. Am. J. Clin. Pathol., 39: 300(Mar. 1963).

Normal and irradiated thyroid glands of rats were studied by means of enzyme visualization technics for plasma membranes, mitochondria, Golgi apparatus, and lysosomes. Animals were killed 2 hr to 2 weeks after intraperitoneal administration of 2.0 μC I^{131} per g body wt. The first change noted in hematoxylin-eosin preparations (swelling of acinar cells) occurred in a small proportion of cells after 4 hr. Within 2 hr after treatment, cytochemical changes were apparent in many cells. The luminal surfaces, especially in the more active (smaller) acini, manifested increased nucleoside and alkaline phosphatase activities. After 8 hr there was an increase in number and also a more widespread distribution of lysosomes. Enlarged lysosomes were present in the Golgi zone after 24 hr; the Golgi lamellae were frequently fragmented or

curled into spherical bodies. Mitochondria manifested little change, even at 48 hr. (H.H.D.)

21478 LATE EFFECTS OF ROENTGEN THERAPY GIVEN IN INFANCY. Brian O'Malley, Giulio J. D'Angio, and Gordon F. Vawter (Harvard Medical School, Boston). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 1067-74(May 1963).

Late complications associated with roentgen therapy of children are discussed and an illustrative case is reported. The patient was irradiated as an infant and developed, over a period of 20 years, lesions exemplifying three of the major categories of late radiation effects. Growth disturbance was sustained by the vertebral spine, functional impairment by the kidneys, and tumor induction by the skin. (auth)

21479 THE SURGICAL TREATMENT OF RADIATION DERMATITIS FOLLOWING IRRADIATION OF BENIGN DISEASES. H. P. Royster and H. B. Lehr (Univ. of Pennsylvania, Philadelphia). Am. J. Surg., 102: 535-41 (Oct. 1961).

A survey is presented of plastic surgical techniques used in 80 patients with radiation dermatitis after exposure to x rays, either accidentally or for a benign disease. The patients illustrate that the use of radiation for treatment of benign disease may be disastrous. All 80 patients with radiation dermatitis had such symptoms from the dermatitis as pruritus, burning, and/or ulceration. The majority of the 80 patients had been given radiation treatment for lesions that were cosmetically unacceptable, in an attempt to improve the appearance of the patient, but the results indicate that it would have been better if the original lesions had been allowed to remain. In 46 irradiated patients (57%) in whom malignancy developed, the incidence of squamous and basal cell carcinoma was almost equal. The average and median time between exposure and diagnosis of malignancy was 27 yr; however, the range was from 9 to 40 yr and the standard deviation was 8.9 yr. In most instances the patients with radiodermatitis who later developed cancer had a history of recurrent ulceration. Surgical treatment consisted usually of excision of the affected area followed by grafting of the skin, although occasionally simple excision and closure were possible. Amputation and/or coverage of the pedicle flap were required in many cases. Since deeper tissues were often severely damaged too, there was a high incidence of failure of the intital graft. There was much oozing from fine teleangiectatic vessels when excision was performed, and hematomas occurred frequently and contributed to the incidence of failure of grafts. Only 17 patients were considered to have made satisfactory recovery from the sequelae of radiodermatitis. (TCO)

21480 SELECTIVE IRRADIATION OF LYMPHATIC TISSUES IN PREPARATION FOR TISSUE HOMOGRAFTING. H. S. Winchell, M. Pollycove, V. Richards, and J. H. Lawrence (Univ. of California, Berkeley). Am. J. Surg., 105: 177-83(Feb. 1963).

A radiation procedure that delivers a larger dose of radiation to lymphatic structures than to other radiosensitive nontarget tissues such as bone marrow or gastrointestinal tract is described. When Y^{90} is chelated with diethylenetriaminepentaacetic acid (DTPA) and administered intravenously, it is found in greater concentration in lymph nodes than in bone marrow or in the ileum. The relative dosages received by various tissues when 10 mC/lb body wt of Y^{90}-DTPA is administered in the dog are: renal cortex 1540 rad, lung 525, gastric mucosa 435, lymph nodes 400, ileum 375, liver 240, bone marrow 115 to 225, muscle 155, and spinal cord 20. The relatively high dose of radiation received by the renal cortex was not found to be prohibitive. It is necessary to reinfuse Y^{90}-DTPA at a rate equal to its rate of excretion in order to maintain a constant level of radioactivity. Four human subjects and 50 dogs were irradiated using the procedure with intravenous urine cycling maintained for 6 hr. The procedure itself was well tolerated in all instances and appeared to be innocuous. Dogs were given doses of radiation in the sublethal and lethal ranges. With an estimated dose of 150 to 210 rad to their lymph nodes all survived over 6 weeks following radiation. In terms of biologic effect, the dosage to lymph nodes is roughly equivalent to more than twice its value of supervoltage x rays. Administration of autologous bone marrow resulted in the survival of the lethally radiated dogs with the return of circulating granulocytes, reticulocytes, and platelets, and absence of significant gastrointestinal symptoms. The circulating lymphocytes, however, failed to show a marked increase. Thus, the critical factor in the death of animals given lethal doses of Y^{90}-DTPA is damage to bone marrow rather than to lymphatic tissue or gastrointestinal mucosa. Four patients with acute lymphatic leukemia treated with Y^{90}-DTPA survived the urine cycling well and remissions of their leukemia were obtained. It is suggested that the procedure is clinically applicable and offers promise in the preparation of human beings for homografting of tissues. (TCO)

21481 VAGINAL CYCLES IN THE RAT AFTER X-RAY OR OTHER DAMAGE TO ONE OR BOTH OVARIES. James C. Plagge and Robert H. Krehbiel (Univ. of Illinois, Chicago). Anat. Record, 144: 287-93(Dec. 1962).

A comparison was made of the effects of various doses of x ray, or other damaging agents, administered to one or both ovaries of the rat at 60 days of age. Irradiations with 800, 2000, or 3000 r were applied to the exteriorized ovary or ovaries. Damage to the rat ovary at 60 days of age caused irregularities in the estrous cycle and continuous cornification of the vagina. The vaginal changes occurred within 2 to 3 months after bilateral irradiation or after bilateral castration and autotransplantation of a portion of one ovary. Unilateral irradiation or ligation of the ovarian arteries at their junction with the uterine artery produced similar changes within 5 to 7 months. Comparable vaginal changes did not occur in control animals until they reached the age of 10 months. Thus the changes in the vaginal cycle produced by damage to the ovary appeared at an earlier age than comparable changes that occur in the aging female rat. It could not be explained why irradiation of one ovary, followed by its removal a short time later, resulted in a higher percentage of cornification than was seen in the untreated or unilaterally ovariectomized female. It may have been an aging process. (TCO)

21482 PALATE MORPHOGENESIS IN MOUSE EMBRYOS AFTER X IRRADIATION. Gerald Callas and Bruce E. Walker (Univ. of Texas, Galveston). Anat. Record, 145: 61-71(Jan. 1963).

The development of cleft palate was investigated by irradiating pregnant female C57BL and A/Jax mice on the 11 1/3 day of gestation with 300-r, whole-body doses and examining the fetuses at subsequent intervals. When palate stage was compared with chronological age, morphological rating, or embryonic weight, it was obvious that intermediate stages of palate closure persisted in x-irradiated embryos long after such stages had been passed in normal embryos. Thus, movement of the palatine shelves from the sagittal to the horizontal plane was retarded by x irradiation. Measurements of head and palate did not show any consistent disproportionality of palate growth in the x-

irradiated embryos except that which resulted from retardation of shelf movement. X irradiation affected A/Jax strain litters more severely than C57BL strain litters according to cleft palate frequency and average palate stage at 18 1/3 days postconception. Cleft palate was seen in 73.1% of strain C57BL fetuses and in 99.5% of A/Jax fetuses. A variety of malformations other than cleft palate were also observed in the offspring of treated mice. Morphologic analysis of cleft palate development after x-ray treatment gave essentially the same results as comparable analyses of cleft palates produced by cortisone, hypervitaminosis A, and riboflavin deficiency. (TCO)

21483 THE EFFECT OF 5.3-Mev POLONIUM-210 ALPHA PARTICLES ON THE ELECTRICAL ACTIVITY OF α- AND β-FIBERS OF THE FROG SCIATIC NERVE. R. M. Berstrom (Univ. of Helsinki, Finland). Ann. Med. Exptl. Biol. Fenniae (Helsinki), 39: 211-15(1961).

Nerve bundles were excised from the sciatic nerves of decerebrated Rana temporaria, and tested by electrical stimulation to obtain a compound spike configuration, which indicated the presence of α- and β-fibers. A typical experiment with a bundle of 5 intact fibers, irradiated with a dose of 6000 rep (1200 rep/min) showed an α-potential decrease of ~50% 20 min after irradiation. The initial decrease of the action potential due to irradiation was observed especially with irradiation doses smaller than 6000 rep. However, this increase in the action potential had a different time course for the α- and the β-elevation of the compound potential. The β-potential increased slightly during the first 2 min, whereas no detectable change in the α-potential was noted. The results indicate that the α- and β-fibers of the sciatic nerve of the frog show a different response to irradiation with heavy particles. The β-fibers seem to be more sensitive to irradiation in that the enhancement of the β-potential appeared earlier than the enhancement of the α-potential. (TCO)

21484 CANCER OF THE BODY OF THE UTERUS AFTER PREVIOUS RADIOTHERAPY. H. H. Schmid (Universitäts-Frauenklinik, Rostock, Ger.). Arch. Geschwulstforsch., 17: 102-7(1961).

The incidence of carcinomas of the corpus uteri after radiation castration in the treatment of benign uterine bleeding is assessed, both from a review of the literature and a survey of cases treated between 1937 and 1957. Over the period such radiotherapy was carried out on 1138 women, 7 of whom later developed cancers of the corpus uteri, an incidence of 0.61%. The latent period for development of the cancers varied from 5 to 10 yr in 4 cases, 10 to 15 in 2, and was 26 hr in 1 case. A review of other studies showed an incidence of 0.3 to 0.6%. Development of uterine cervical cancer following such radiotherapy was 4 to 5 times more frequent than that of cancer of the body of the uterus. Since the incidence of cancer of the corpus uteri in unirradiated women is not significantly lower than the rates cited here and in the literature, it was concluded that no etiologic relation to irradiation is demonstrable. (H.H.D.)

21485 DNA SYNTHESIS IN THE RAT LENS EPITHELIUM AFTER ROENTGEN IRRADIATION. Luigi Scullica, Patricia Grimes, and Norma McElvain (National Inst. of Neurological Diseases and Blindness, Bethesda, Md.). Arch. Ophthalmol., 68: 792-800(Dec. 1962).

The effects of x irradiation on DNA synthesis and mitotic activity were studied in whole flat mounts of the rat lens epithelium by means of autoradiography after labeling with thymidine-H^3. Exposure of 1 eye to 1000 r resulted in complete inhibition of mitosis from 2 to 24 hr after irradiation. During this interval the number of cells incorporating thymidine-H^3 decreased gradually to 40% of the control value at 8 hr, and at 24 hr there was almost complete absence of labeled cells in the irradiated eye. Both mitotic activity and thymidine-H^3 uptake resumed after 24 hr and increased steadily until normal values were reached ~5 days after irradiation. Subsequently, the number of mitoses and labeled cells was consistently greater in the irradiated epithelium than in the control. The observations indicate that a dose of 1000-r x rays, in addition to blocking mitosis, temporarily depresses DNA snythesis in the lens epithelial cells. The effect on DNA synthesis is independent of the mitotic inhibition and appears to be due to a presynthetic block, which prevents new cells from entering the S period, and to a block of synthesis in some of the cells in the S period at the time of irradiation. (TCO)

21486 ON THE COURSE OF RADIATION CATARACT IN THE SYMPATHECTOMIZED RABBIT EYE: A CONTRIBUTION TO THE PROBLEM OF UNILATERAL SPONTANEOUS CATARACT. Juergen Gaertner (Universitäts-Augenklinik, Heidelberg). Arch. Ophthalmol., 162: 471-85 (1960).

To elucidate the role of sympathetic innervation on the development of cataracts, rabbits were submitted to right-sided section of the cervical sympathetic nerve and removal of the cervical ganglion. Both eyes were then x irradiated with 1500, 2500, or 3200 r, and eyes of nonoperated controls were irradiated with 1500 r. Examination of the eyes for periods up to 526 days after irradiation showed no differences, either in the time of appearance of cataract or its course of development, attributable to sympathectomy. After 1500 r the first sign of radiation injury to the lens was seen as small subcapsular vacuoles in the anterior cortex. Several weeks later vacuoles appeared in the posterior cortex and progressively spread until the entire lens became opaque. In some eyes the development of a severe ulcerative keratitis completely obscured changes in the lens, and with the higher x-ray doses it became more difficult to follow the stages of cataractogenesis. After 2500 and 3200 r the minimum time required for complete lenticular opacity was 156 days, in contrast to 242 days after 1500 r. The results show that radiation cataractogenesis, at least, is not influenced by sympathetic innervation. (H.H.D.)

21487 EFFECTS OF X RAY ON THE TYMPANAL MESENCHYME CYCLE; EXPERIMENTS ON THE WHITE RAT. Paul Guggenheim, Leo Clements, Allen Schlesinger, Patrick Peartree, William Jurgensen, and Raymond McDonald (Creighton Univ., Council Bluffs, Iowa). Arch. Otolaryngol., 74: 185-8(Aug. 1961).

The effects of ionizing radiation upon unresorbed embryonic mesenchyme in the middle ear were investigated in view of the use of x-ray treatment in certain pediatric otologic problems. Attempts were made to detect any effects of x rays, administered in doses comparable to those used in human therapy, upon the tympanal mesenchyme of the rat. Six-day-old rats were given a single 150-r dose, aimed from ventrally at the right half of the head, through a small port in an otherwise all-encompassing lead shield. Thus, the right tympanic bulla was penetrated with very small perpendicular scatter to the left bulla. Histologic sections of control and irradiated ears, obtained 1 to 7 days later, were compared. No significant difference between irradiated and unirradiated ears was observed. It was concluded that no significant effect was noted in retarding growth during the active phase (birth through 11th day), or in hastening involution during the subsequent pe-

riod of decline. The negative results obtained on the ongoing cycle of growth and resorption in the rat would not seem to hold out much hope of thus influencing favorably the more chronic, stable state of retained tympanal mesenchyme in children. (TCO)

21488 THE CANCEROGENIC EFFECT OF X RAY ON THE LARYNX. Janusz Wlodyka (Laryngology Clinic, Academy of Medicine, Krakow). Arch. Otolaryngol., 76: 372-6 (Oct. 1962).

Six cases are cited showing that radiotherapy of benign larynx papillomas considerably increases the possibility of later malignancy. Out of the 6 cases of laryngeal papillomas, which became malignant during the period from 1950 to 1959, in 4 patients radiotherapy had been previously given. Malignancy occurred 5 months, and 8, 14, and 15 yr after irradiation. A case of laryngeal carcinoma was also observed in a woman who had been treated twice with x rays for a tuberculous lymphadenitis of the neck 19 yr previously. The other 4 cases were all men aged 34 to 53 yr old who had received 30 to 40 irradiation treatments; in only one case could the dose be determined (6200 r). The literature relating to radiotherapy-induced cancer of the larynx is also reviewed. (H.H.D.)

21489 RADIOIODINE-INDUCED THYROID CARCINOMAS IN FEMALE RATS; INDUCTION BY LOW DOSES OF RADIOIODINE. S. Lindsay, G. D. Potter, and I. L. Chaikoff (Univ. of California, San Francisco). Arch. Pathol., 75: 8-12(Jan. 1963).

The development of neoplasms was studied in thyroid glands of female Long-Evans rats 2 yr after they had received 3 separate injections at monthly intervals of 10 μC of I^{131}. Benign thyroid nodules or adenomas were observed in 39% of the 49 rats given the I^{131}, whereas only 1 of the 31 control rats displayed a thyroid adenoma. Papillary carcinomas of low-grade malignancy were observed in 3 female I^{131}-treated rats (6%); no follicular carcinomas developed in them. The incidence of both benign and malignant thyroid neoplasms found in female rats injected with low doses of I^{131} was lower than that in male rats, 96% of which developed thyroid adenomas. It appears that the proliferative response with development of benign and malignant thyroid neoplasms is significantly less active in the female rat thyroid gland than in the male. An almost equal incidence of papillary and follicular carcinomas was induced in male rats by I^{131}. The majority of the follicles of the thyroid glands of the I^{131}-treated rats was smaller than those in normal rats and contained granular, degenerating colloid. The incidence of proliferative lesions of the parathyroid glands (hyperplasia and/or adenoma) was slightly higher in the I^{131}-treated female rats than in I^{131}-treated males (47% and 33%, respectively), although the incidence in I^{131}-injected and control female rats was about the same (47% and 42%). (H.H.D.)

21490 DOES UNILATERAL EXTIRPATION OF THE CERVICAL SYMPATHETIC GANGLION INFLUENCE THE DEVELOPMENT OF RADIATION CATARACT IN THE RABBIT? J. Gaertner (Universität, Heidelberg). Ber. Deut. Ophthalmol. Ges., 63: 448-9(1961).

Removal of the cervical sympathetic nerve and ganglion prior to x irradiation of the eye of rabbits did not alter the development of cataract. Hence the concept that vasomotor disturbances of autonomic origin are involved in the pathogenesis of human senile cataract was not substantiated. (H.H.D.)

21491 THE GENE-CONTROLLED RADIATION SENSITIVITY IN ESCHERICHIA COLI. A. Roersch, A. Edelman, and J. A. Cohen (Rijksverdedigingsorganisatie, TNO, Rijswijk, Netherlands). Biochim. Biophys. Acta, 68: 263-70 (Feb. 26, 1963). (In English)

The position of the genetic determinant syn on the chromosome of Escherichia coli strain B was determined by conjugation experiments. This syn marker, which affects the radiation sensitivity of the strain, is located between the markers controlling xylose fermentation and streptomycin resistance. The fertility factor of E. coli K 12 strain was transferred to an auxotrophe of a radiation-sensitive mutant of E. coli B (syn^-). By subjecting the latter to conjugation with E. coli C the syn^- marker was transferred to that strain. Besides its increased ultraviolet-light sensitivity a syn^- strain differs from the wild type (syn^+) by its decreased ability to propagate ultraviolet-inactivated bacteriophage T_1, T_3, T_7 and λ. It is concluded that like the u gene of bacteriophage T_4, the bacterial syn gene controls a process, concerned with the repair of ultraviolet-light lesions. (auth)

21492 THE EFFECT OF ULTRAVIOLET IRRADIATION OF ESCHERICHIA COLI STRAIN B ON THE SUCROSE-GRADIENT-SEDIMENTATION PATTERN OF ITS CELL-FREE EXTRACT. A. Roersch, A. Edelmann, and J. A. Cohen (Rijksverdedigingsorganisatie, TNO, Rijswijk, Netherlands). Biochim. Biophys. Acta, 68: 271-7(Feb. 26, 1963). (In English)

The effect of ultraviolet irradiation and treatment with chloramphenicol and puromycin of whole cells of Escherichia coli B and its radiation-sensitive mutant E. coli B syn^- on RNA synthesis, was studied by fractionation of cell-free extracts in a sucrose gradient. Extracts of fully P^{32}-labeled cells sediment in three distinct peaks of, respectively, 50 S, 30 S, and 4 S. In extracts from cells exposed for 5 min to $P^{32}O_4^{3-}$ the label sediments exclusively in the region between 4 and 30 S. Ultraviolet irradiation does not alter this sedimentation pattern significantly. In extracts from cells exposed for 5 min to $P^{32}O_4^{3-}$ followed by a 20-min chase by cold phosphate the label is transferred to the 30-S and 50-S ribosome fractions. This sedimentation pattern is altered in a distinct way if the cells have been exposed to a dose of 200 erg/mm^2 ultraviolet light. In the wild-type E. coli B syn^+ 4-S material accumulates, in the radiation-sensitive mutant E. coli B syn^- in addition to 4-S, 20-S material accumulates. In both strains 20-S material accumulates to the same extent after treatment with chloramphenicol. If the wild type is irradiated with a dose of 400 erg/mm^2 ultraviolet light the sedimentation pattern of its cell-free extract resembles that of an extract from the radiation-sensitive mutant after irradiation with 200 erg/mm^2. So the difference between the strains with respect to their reaction on ultraviolet irradiation is rather more of a quantitative nature than of a qualitative one. This result is in accordance with the hypothesis previously postulated that the strains do not differ in their primary interaction with ultraviolet light. (auth)

21493 VARIATIONS IN SEVERAL RESPONSES OF HeLa CELLS TO X-IRRADIATION DURING THE DIVISION CYCLE. Toyozo Terasima and L. J. Tolmach (Mallinckrodt Inst. of Radiology, St. Louis and Washington Univ., St. Louis). Biophys. J., 3: 11-33(Jan. 1963).

Several responses of synchronized populations of HeLa S3 cells were measured after irradiation with 220 kev x rays at selected times during the division cycle. Survival as demonstrated by colony-forming ability, was maximal when cells were irradiated in the early post-mitotic (G_1) and the pre-mitotic (G_2) phases of the cycle, and minimal

in the mitotic (M) and late G_1 or early DNA synthetic (S) phases. Markedly different growth patterns resulted from irradiation in different phases. Prolongation of interphase was minimal when cells were irradiated early in G_1 and rose progressively through the remainder of the cycle. Cells irradiated while in mitosis were not delayed in that division, but the succeeding division was delayed. Persistence of cells as metabolizing entities did not depend on the phase of the division cycle in which they are irradiated. Characteristic perturbations of the normal DNA synthetic cycle occurred. Cells irradiated in M suffered a small delay in the onset of S, a slight prolongation of S, and a slight depression in the rate of DNA synthesis, and the major delay occurred in G_2. Cells irradiated in G_1 showed no delay in the onset of S, and essentially no alteration in the duration or rate of DNA synthesis, and G_2 delay was minimal. Cells irradiated in S suffered an appreciable S prolongation and a decreased rate of DNA synthesis. G_2 delay was shorter than S delay. (auth)

21494 X-RAY AND ULTRAVIOLET SENSITIVITY OF SYNCHRONOUSLY DIVIDING ESCHERICHIA COLI. Charles E. Helmstetter and Robert B. Uretz (Chicago Univ.). Biophys. J., 3: 35-47(Jan. 1963).

A paper pile filtration technique was used to obtain synchronously dividing populations of E. coli strains B and B/r from cultures in the exponential growth phase. Three generations of highly phased cell division were obtained by rapid pressure filtration which selected approximately 1 per cent of the exponentially growing culture. The sensitivity of E. coli strain B to x ray and uv inactivation as a function of the cell division cycle was determined on synchronous populations. E. coli strain B showed a sharp decrease in sensitivity to inactivation by both radiations in the middle of the division cycle, and a further decrease near the end of the cycle. The sensitivity of E. coli and B/r to x irradiation was also investigated. Only the mid-cycle decrease in sensitivity was found during the division cycle of this strain. It was concluded that the repetition of the observed sensitivity patterns in both strains through the first three cycles after synchronization indicates that the same basic sensitivity patterns are probably also present in the individual cells of an exponential phase culture. (auth)

21495 STUDIES OF TOXOPLASMA GONDII IN CELL CULTURES BY MEANS OF IRRADIATION EXPERIMENTS. Ebba Lund, E. Lycke, and P. Sourander (Univ. of Gothenburg, Sweden). Brit. J. Exptl. Pathol., 42: 404-7(Oct. 1961).

A study was made of parasite-cell interactions after irradiation of cell cultures and parasites prior to the inoculation and the effect of the irradiation on parasite-infected cells. This was done to see whether inhibition of mitotic activity affected parasite propagation. The parasites and cells (HeLa and Detroit-6) were exposed to 250-kv x rays at doses of 600 to 3000 r or to Co^{60} gamma rays at doses of 30000 to 120,000 rad. After 600 to 3000-r x irradiation the parasites did not behave differently from nonirradiated ones with regard to infection and multiplication rates as well as antigenic properties in the Sabin dye test. Gamma irradiation did not change the stainability of the parasites or the antigenic properties as measured by the dye test. Parasites irradiated with 30000 rad or more penetrated the cells just as untreated ones, but whereas nonirradiated parasites multiplied intracellularly and caused cell burst within 48 hr, the irradiated parasites did not divide. Two-day-old HeLa or Detroit-6 cells exposed to 600 to 3000 r showed after 48 hr a number of giant cells, and the number of such atypical cells increased gradually. In cultures infected with toxoplasma 48 hr after x-ray treatment, microscopic examinations revealed no differences between irradiated cultures with respect to parasite multiplication. The development of parasites in the giant cells proceeded in the same way as in the nonirradiated cells. Cell cultures exposed to 30000 to 120000 rad showed not only inhibition of mitotic activity but grave cell damage on the day following the irradiation. When gamma-irradiated cells were infected with parasites, the multiplication of parasites proceeded at the same rate as in untreated cultures, resulting in clone formation and cell rupture. Even dying cells that had been treated with 120000 rad allowed parasite multiplication. (TCO)

21496 THE ABLATION OF NORMAL THYROID TISSUE WITH IODINE 131. A. W. Goolden and Jane B. Davey (Hammersmith Hospital and Postgraduate Medical School, London). Brit. J. Radiol., 36: 340-5(May 1963).

It was found that the minimum radiation dose of I^{131} for complete ablation of the thyroid gland is probably between 30000 and 40000 rads, but for practical purposes it is safer to assume that it may be as high as 50000 rads. A radiation dose of 50000 rads requires an initial concentration of about 1 mC of I^{131}/g of thyroid tissue, but, if the rate of turnover of I^{131} in the thyroid is very rapid, a higher initial concentration may be necessary, and this must be taken into account when calculating the amount of I^{131} that has to be given to the patient. Failure to ablate the thyroid completely in patients with angina is not a serious matter provided the patient becomes sufficiently hypothyroid after the treatment. It is advisable, on the other hand, to ensure complete destruction of all remaining thyroid tissue in patients who have had one lobe containing a thyroid carcinoma removed. Doses of 80000 to 100000 rads, which produce massive destruction of thyroid tissue, may be indicated in these circumstances. (P.C.H.)

21497 COMPARISON OF IODINE 124 AND IODINE 131 FOR THYROID ABLATION. A. W. G. Goolden, J. F. Fowler, and C. M. E. Matthews (Medical Research Council and Hammersmith Hospital, London). Brit. J. Radiol., 36: 346-9(May 1963).

Three patients were given therapeutic doses of I^{124} to ablate residual normal thyroid tissue following surgical removal of one lobe. The amount of I^{124} (in millicuries) required for ablation was found to be about equal to (0.7 to 1.5 times) the amount that gives the same mean calculated dose in rads to the gland as the amount of I^{131} required for ablation. The significance of this is discussed in relation to the gain factor of the more uniform radiation from I^{124} compared with I^{131}. In thyroid carcinoma where there are larger regions of low uptake, the gain factor may be much greater. (P.C.H.)

21498 THE ABSORBED DOSE IN CYLINDRICAL CAVITIES WITHIN IRRADIATED BONE. N. Aspin and H. E. Johns (Univ. of Toronto). Brit. J. Radiol., 36: 350-62(May 1963).

A method is presented for measuring the energy absorbed near an interface in a medium exposed to a beam of x rays. The method developed is not simple and involves unavoidable inaccuracies since it employs a biological indicator. Nevertheless, direct measurements of the energy absorbed in small cavities within a high atomic number material were made. A theoretical method for calculating the energy absorbed in cylindrical cavities was also developed. The results of the calculations show good agreement between experimental and theoretical results. Since the experimental method is very difficult and time consuming, it

is not recommended as a routine method of measuring the energy absorbed near an interface. However, good agreement between the experimental and theoretical results indicates that for most problems of this nature in radiotherapy and radiobiology, calculated values of the absorbed dose can be used with confidence. The data for monoenergetic photons may be used to calculate the absorbed dose for any continuous spectrum of radiation. (P.C.H.)

21499 A MORPHOLOGICAL STUDY OF THE X-RAY INDUCED CAULIFLOWER-HEAD AND SINGLE-LEAF MUTATION IN MEDICAGO SATIVA L. I. L. Bayly and Iris L. Craig (Carleton Univ., Ottawa). Can. J. Genet. Cytol., 4: 386-97(Dec. 1962).

A comparison was made of the morphology of a spontaneous and an x-ray induced cauliflower-head and single-leaf mutation with that of normal alfalfa. Chromosome numbers were 32 in the normal and the spontaneous mutation, 31 in some, but not all, of the x-ray induced lines. The cauliflower mutant is unrelated to the trisomic tetraploid condition of the B45 line. Flower development in x-ray induced cauliflower-head is restricted to profusely branched floral axes, which produce only meristem primordia, and under treatment with gibberellic acid, rudimentary pistils, but still no stamens, petals, or sepals. Flower development in the spontaneous mutation shows sparingly branched floral axes, which produce rudimentary pistils and linear bracts homologous with sepal-petal primordia. With gibberellic acid treatment, pistil development approaches normal. Leaf development, which is trifoliate in normal alfalfa, is unifoliate in both mutants. The unifoliate leaf appears to result from suppression of lateral leaflet primordia. It is suggested that the x-ray induced mutation, although similar, is more extreme and rudimentary in tissue differentiation than the spontaneous mutation. (TCO)

21500 MUTAGENIC EFFECT OF C^{14}- AND H^3-LABELED DNA PRECURSORS INJECTED INTO DROSOPHILA MELANOGASTER MALES. Oistein Strommaes (Univ. of Oslo). Can. J. Genet. Cytol., 4: 440-6(Dec. 1962).

Male larvae were injected with adenine-C^{14}, cytidine-H^3, and thymidine-H^3 to determine which would give the highest induced mutation rate with this level of commercially available radioactivity. With regard to sex-linked recessive lethals, all mutation frequencies were significantly higher in experiments in which radioactive chemicals had been injected instead of inactive precursors of DNA. The mutation frequency was highest after adenine-8-C^{14} was injected into larvae, but there was no statistical difference whether tritium was present as tritiated cytidine or tritiated thymidine. The overall hatchability for all broods was about 98%. There was no indication that radioactivity induced a higher dominant lethal mutation rate. To verify that the radiochemicals had reached the sperm by the technique used, it was established that sperm transmitted to females were radioactive. Variation in mutation frequency between the radioactive groups was not significant. The mutation frequency increased until 12 to 13 days after injection when the frequency reached a peak and then fell off again. The data suggest that sex-linked recessive lethals may be used as a measure of the mutagenic effect of radiochemicals of the type employed. (TCO)

21501 EFFECTS OF X RAYS ON MITOSIS OF MAMMALIAN CELLS CULTURED IN VITRO. Angelo Gino Levis (Università, Padua). Caryologia, 15: 59-87(Jan.-Apr. 1962). (In Italian)

Cells of strain RCP isolated from guinea pig kidney were irradiated at a rate of 150 r/min with 180-kv x rays to doses of 150, 300, and 450 r. Studies were made of variations of mitotic index and frequencies of nuclear damage after exposure. The earliest recognizable effect of irradiation was a transitory inhibition of mitotic division in cells that were about to divide at the time of irradiation. The mitotic depression and length of the mitotic delay were proportional to dosage. After mitotic inhibition a partial synchronization of the cell population occurred. At the same time a mitotic block was induced as a result of several metaphasic alterations. Chromosome bridges were quantitatively recorded in anaphasic, telophasic, and interphasic cells at different times after irradiation. Giant cell induction was one of the most obvious effects of irradiation and may be related to chromosome-induced damage. Several nuclear alterations, such as multipolar spindles and micronuclei, showed an incidence proportional to the radiation dose and were considered to be a consequence of giant cell formation. At 72 hr after 450 r, multipolar spindles and micronuclei were found in 20 and 12% of the cells, respectively, compared with incidences of 2% and <1% in unirradiated cells. (TCO)

21502 MITOSES — ACANTHOSIS — X RAYS. W. Jadassohn (Clinique Universitaire de Dermatologie, Geneva). Chemotherapia, 2: 178-90(1961). (In French)

Marked acanthosis resulted 4 days after topical application of estrogen to the nipple of male guinea pigs. A relatively low dose of locally applied x radiation (400 r) completely inhibited the reaction, and the skin was refractory to estrogen-induced acanthosis for 5 days. With 1600 r the recovery phase was prolonged to 20 days. On other areas of guinea pig skin the reaction could be stimulated by estrogen, but other substances induced mitoses and acanthosis, such as erucic acid and chrysarobin. This reaction was also inhibited by x rays. Larger repeated doses of estrogen applied to the nipple of male guinea pigs caused mitotic activity and hypertrophy of the mammary gland resembling that seen in gravid females. This reaction was also inhibited by 400-r irradiation. Similar doses of x radiation were used to inhibit mitoses in some human skin lesions, such as condyloma acuminatum (venereal warts). Doses of 800 r were observed to diminish the number of mitoses (blocked by colchicine) in hair follicles also. By varying the x-ray tube voltage and Al filtration, it was possible to deliver appropriate doses to guinea pig mammary glands without causing appreciable changes in epidermis. It was also found that 70-kv operation with 0.5-mm Al filtration minimizes the effect of medicated ointments on human skin. (TCO)

21503 RELATIONS BETWEEN ROOT GROWTH AND SENSITIVITY OF ROOT MERISTEM TO VARIOUS RADIOMIMETIC AGENTS IN VICIA FABA. R. Rieger and A. Michaelis (Deutsche Akademie der Wissenschaften, Berlin). Chromosoma, 11: 573-81(1961). (In German)

The sensitivity pattern of the V. faba main root meristem against the radiomimetic compounds ethanol, Myleran, and nitrogen mustard (HN-2) was found to be dependent on root length. In the case of ethanol sensitivity, measured by the percentage of metaphases with chromosome aberrations, it was similar in 2- and 4-cm roots. Further enlargement of roots up to 10 cm in length caused a drastic decrease in the number of damaged cells. The decrease was not so striking and happened later when Myleran and HN-2 were used. No sensitivity differences between 2-cm-long main and lateral roots were found when treated with Myleran or HN-2. On the contrary, lateral rootlets showed practically no aberrations after treatment with ethanol, the percentage of damaged cells in the main root meristem

being 44%. The results are discussed in relation to whether the sensitivity differences are real or only spurious. It was concluded, that changes in the sensitivity pattern are true and probably caused by metabolic changes in the meristem cells, correlated with growth of the root, and upon which the 3 radiomimetic compounds reacted differently because of different modes of action. (H.H.D.)

21504 SEROTONIN AND THE LOCAL EFFECT OF X RAYS. 4. PROTECTION EFFECT OF SUBSTANCES RELATED TO SEROTONIN AGAINST X RAYS. A. Maggiora and R. Brun (Clinique Universitaire de Dermatologie, Geneva). Dermatologica, 126: 30-9(1963). (In French)

Eleven substances related to serotonin (5-hydroxytryptamine) were tested in guinea pig skin for protection against the epilating action of local 800-r doses of 50-kv x irradiation. The substances were injected intraperitoneally in 15-mg doses and their protective effects compared with those of serotonin. Some protection was afforded by 5-hydroxytryptophan and tryptophan but to a less extent than serotonin. No anti-epilatory action was noted with the following: indole, 5-hydroxyindole, 5-hydroxyindoleacetamide, 5-hydroxyindoleacetic acid, indoleacetic acid, tryptamine, psilocine (N,N-dimethyl-4-hydroxytryptamine), and psilocybine (the phosphate derivative of the preceding compound). The only compound tested that showed protection equal to that of serotonin was bufotenine (N,N-dimethyl-5-hydroxytryptamine). The results indicate that the protective action of serotonin is dependent upon both the phenolic hydroxyl group in position 5 and the primary amine, although dimethylation of the amine group does not impair activity. The radioprotective activity of some of these substances may depend upon their partial in vivo transformation to serotonin. (TCO)

21505 CHANGES IN THE PHENOLIC MATERIALS COMPLEX IN THE CASE OF MECHANICAL INJURIES OF POTATOES AFTER EXPOSURE TO γ-RADIATION. E. N. Mukhin (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 148: 1405-7(Feb. 21,1963). (In Russian)

Previous studies indicated that potatoes which were irradiated for suppressing germination are more sensitive to spoilage microorganisms. This question was investigated by determining the concentration of various phenolic materials during the regenerative process. Potatoes were exposed to 10,000 and 100,000 r at a dose rate of 1340 r/minute after a storage period of 3 to 4 months. Segments were removed after incisions were made on the external surface and were kept in darkness at a temperature ranging from 18 to 21°C. After a period of 3, 7, and 14 days, samples of the injured tissue were analyzed by paper chromatography. Determination of the phenolic materials indicated that the action of the γ-radiation results in the decrease of the chlorogenic acid content and the appearance of caffeic acid which is absent in the parenchymatous tissue of the tuber. The concentration change is linearly proportional with the radiation dose. It is assumed that these compounds play an important role in the regenerative process. (TTT)

21506 THE EFFECTS OF CONTINUOUS GAMMA RADIATION ON THE INTRINSIC RATE OF NATURAL INCREASE OF DAPHNIA PULEX. J. S. Marshall (Univ. of Michigan, Ann Arbor). Ecology, 43: 598-607(1962).

The effects of continuous sublethal Co^{60} radiation on the intrinsic rate of natural increase, r, was studied. An analysis was also made of the effects of radiation on the population attributes underlying r, namely, birth rate, b, death rate, d, and stable age-distribution. Each of 18 experimental populations was exposed to a different, continuous dose rate, ranging from 25 to 75 r/hr. The results showed that r decreased continuously as a nonlinear function of the dose rate (although ~ a linear function of the square of the dose rate). The effects of increasing dose rate on the stable age-distribution were mainly a decrease in the proportion of individuals in the youngest age groups and an increase in the proportion of older individuals. The overall results indicate that the reduction of fecundity and fertility was due to direct effects of the radiation on the ovaries rather than to indirect, physiological effects. It was considered likely that dominant lethal chromosome aberrations were ultimately responsible. Individual life expectancy at birth, or average life-span, was not greatly shortened by any of the dose rates employed. Furthermore, age-specific survival rates were not affected until late in reproductive life. Individual growth in length increased with increasing dose rate. (TCO)

21507 CHARACTERIZATION OF PHOSPHATASE IN A TERRESTRIAL SOIL STERILIZED WITH AN ELECTRON BEAM. J. J. Skujins, L. Braal, and A. D. McLaren (Univ. of California, Berkeley). Enzymologia, 25: 125-33(Nov. 15, 1962).

Studies were made on phosphatase inactivation by radiation in soil, in comparison with inactivation of a purified phosphatase of plant origin. Dublin adobe clay loam was irradiated with an electron beam at 5 Mev or γ irradiation with a Co^{60} source. The soil samples were irradiated with the electron beam up to 22×10^5 rep and with γ rays up to 16×10^6 rep doses. The per cent value of the remaining phosphatase activity in soil was based on the activity in soil irradiated with a 5×10^6 rep dose (taken as 100%). Complete sterility was obtained at this dosage. Potato acid phosphatase was irradiated with the electron beam up to a 16×10^6 rep dose. Enzymatic activity of acid phosphatase was determined on the soluble fraction of the commercially available product. There was no significant change in the amount of the soluble protein fraction upon irradiation and the per cent remaining activity was based on the 100% value of nonirradiated enzyme. The inactivation of soil phosphatase activity ($k = 0.05$) followed the equation $\ln(A/A_0) = -kD$ and required essentially the same radiation dose as the purified potato acid phosphatase ($k = 0.06$), if irradiated with 5-Mev electrons. The dose required to reduce the initial activity to 37% was 17 Mrep for potato acid phosphatase and 19 Mrep for soil phosphatase activity following a sterilization dose of 5-Mev electrons. The greatest phosphatase activity in Dublin soil was observed to be at around pH 6.0 with a broad optimum between pH = 5.5 and pH = 8.0. It is of interest that the maximum phosphatase activity is that of the natural pH of the soil (pH = 5.8). Soil phosphatase is probably a mixture of enzymes having origin in several kinds of microorganisms. (TCO)

21508 NEUROLOGICAL DEFICITS IN THE RAT RESULTING FROM X IRRADIATION IN UTERO. Melvin R. Sikov, Corrine F. Resta, James E. Lofstrom, and John S. Meyer (Wayne State Univ., Detroit). Exptl. Neurol., 5: 131-8(Feb. 1962).

The effects of prenatal irradiation were investigated by exposure of pregnant rats to 20 or 100 r after 10 days of gestation or 50 or 185 r after 15 days. The incidence and severity of neurological deficits was greatest in the rats treated with 185 r after 15 days of gestation. The incidence was lower in the remaining groups, but of statistical significance in some cases. A higher percentage of defects was

found among female than male offspring. In some animals, evidence of altered behavior was first seen at birth, while others appeared normal until more mature. The resulting neurological syndrome included loss of righting reflex or impairment of placing and hopping reactions. Some displayed hypersensitivity, manifested as exaggerated myoclonic jerks in response to sensory stimuli. Spasticity of hind limbs was found only in the 15-day, 185-r rats; at times this was accompanied by a hind-limb ataxia, which was also noted in other groups. Some animals displayed a convulsive disorder similar to the Jacksonian seizure of man. Other neurological deficits noted were gait defects, backing-up, and forced circling. At the time of puberty, many males developed priapism, which persisted until death. The neurological deficits correlate well with the morphological lesions. Radiation at 15 days of gestation produced a number of morphological abnormalities of the cerebrum, which included reduction in size, absence of certain structures, defective cell formations, as well as heterotopic development of various areas. It is suggested that radiation during embryonic life may act to produce biochemical alterations with associated metabolic defects, which are not necessarily associated with cell loss but may be associated with or result in malformations. (TCO)

21509 PHANTOMS OF PARTS OF HUMAN BODIES FOR USE IN RADIOLOGY. A. J. Stacey, A. R. Bevan, and C. W. Dickens (Royal Cancer Hospital, London; Natural Rubber Producers' Assn., Welwyn Garden City, Hertfordshire, Eng., and Royal Marsden Hospital, London). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 98: 351-5(Mar. 1963). (In German)

Interactions between ionizing radiations and the tissues of the human body have been studied for many years. These studies, however, are by no means easy, since measurements on humans usually entail either undesirable additional radiation exposures or the positioning of measuring instruments within the body. This problem was solved by the fabrication of artificial bodies, so-called "phantoms", which are constructed from a tissue-equivalent fluid rubber compound. Their fabrication, properties, and their main uses are described, which fall under three headings: diagnostic radiology, radiotherapy, and protection from radiation. (auth)

21510 TANTALUM-182 THERAPY OF VULVA CARCINOMAS. PHYSICAL DATA, DOSIMETRY APPLICATIONS AND TECHNIQUES, AND RESULTS. A. Jakob (Stadtische Krankeanstalten, Nuremberg). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 98: 439-45(Apr. 1963). (In German)

Experiences with Ta-182 therapy of vulva carcinoma are described. A description is given of the spectrum, the half-value-layer of Ta 182 in water and lead, the dose distribution in tissue, dosimetry, technique of application, and protection of the attending personnel. The results are discussed which were obtained so far on 31 patients since 1955. Radio-tantalum is particularly indicated on old patients or those with heart and circulation troubles, on whom an operation cannot be risked. The strain on the patient is small; the operation is quick, simple and without danger; rest in bed is not always required; no mutilation occurs; the costs are low; and the radiation burden for therapist and nursing personnel is small. (auth)

21511 SCINTOGRAPHIC DIAGNOSIS OF TUMOR METASTASES. W. Sinner (Universitlit, Zurich). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 98: 446-60 (Apr. 1963). (In German)

Scintography after the administration of appropriate radioisotopes is a valuable method of investigation which can demonstrate and localize primary and secondary malignant tumors. Metastases can readily be demonstrated in parenchymatous organs which, because of lack of radiographic contrast, cannot be examined by other means. This is of value in the choice between curative, palliative, or prophylactic treatment, whether by surgery, radiotherapy, or drugs. It helps to avoid useless and dangerous radical operations in advanced cases which are technically or prognostically inoperable. (auth)

21512 TECHNIQUE AND VALUE OF GAMMA ENCEPHALOGRAPHY. S. Wende (Freie Universität, Berlin). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 98: 466-76(Apr. 1963). (In German)

Gamma encephalography proved to be a valuable means of neuroradiological examination. Its value lies in its ability to give information regarding the site and nature of cerebral lesions. Details of the technique are given. (auth)

21513 X-RAY INDUCED VISIBLE MUTATIONS IN HABROBRACON OOCYTES. Anna R. Whiting (Univ. of Pennsylvania, Philadelphia and Marine Biological Lab., Woods Hole, Mass.). Genetics, 48: 491-5(Apr. 1963).

Dominant lethal, recessive lethal, and visible mutations occur in similar percentages in primary oocytes of Habrobracon x-rayed in a resistant stage, first meiotic prophase (LD_{50} = 12,000 r), and in a sensitive stage, first meiotic metaphase (LD_{50} = 400 r), after comparable doses, 25,000 r and 1100 r respectively. (auth)

21514 FAILURE TO DETECT AN ANTI-MUTAGENIC EFFECT OF CHLORAMPHENICOL IN ULTRAVIOLET-TREATED POLAR CAP CELLS (EARLY GERM TRACK) OF DROSOPHILA. Luolin S. Browning and Edgar Altenburg (Texas Medical Center, Inc., Houston). Genetics, 48: 525-8 (Apr. 1963).

The ultraviolet-induced rate of second chromosome lethals in Drosophila was not significantly reduced by post-treatment of ultraviolet-treated polar-cap cells (the early-germ track) with chloramphenicol, even when the parents of the treated eggs and the developing embryos were in addition reared on chloramphenicol-containing food, as indicated by the following data: ultraviolet-induced rate without chloramphenicol posttreatment, 2.0 ± 0.7 percent; with posttreatment, 1.3 ± 0.7 percent. The control rate was 0.7 ± 0.3 percent. Although the ultraviolet-induced rate was rather low (2.0 ± 0.7 percent), the rate ofter chloramphenicol treatment (1.3 ± 0.7 percent) was still close enough to the induced rate to indicate that the chloramphenicol was not obliterating the induced rate, contrary to what would have occurred in the case of bacteria. (auth)

21515 X-RAY DOSE RATE AND DOSE FRACTIONATION STUDIES ON MUTATION IN PARAMECIUM. R. F. Kimball (Oak Ridge National Lab., Tenn.). Genetics, 48: 581-95(Apr. 1963).

The contribution of two-hit mutational events to x-ray induced lethal and slow-growth mutation in Paramecium aurelia was estimated by dose-rate and dose-fractionation studies. The half-life of the lesions producing the two-hit events is of the order of minutes under log phase conditions, whereas our earlier work shows that the half-life for one-hit, reparable premutational lesions is of the order of hours. Both types of lesions have longer half-lives in stationary phase, as shown in our earlier work for one-hit damage, and in the present study for two-hit. At least two kinds of reparable lesions are induced in

chromosomes by x rays. These include a lesion with a short half-life in log phase that can interact with similar lesions to produce two-hit events, and a lesion with a longer half-life that is unable to interact to produce two-hit events, and produces final mutation only when the chromosomes duplicate. The first lesion is presumed to be a chromosomal break that can interact to produce chromosomal aberrations, and the second lesion is presumed to be the reparable precursor of point mutations. Genetic evidence for this identification is not available, however. The relative contribution of these two kinds of lesions to the final mutation will depend on the dose, on the relation of the dose rate to the rate of rejoining of the breaks, and on the rate and time available for repair of the precursor of point mutation. This latter type of lesion can contribute most of the mutations under some conditions, essentially none under others. (auth)

21516 CYTOGENETIC STUDIES OF X-RAY AND INGESTED P^{32}-INDUCED SEX-LINKED RECESSIVE LETHALS IN DROSOPHILA MELANOGASTER. Kirsten H. Walen (Norsk Hydro's Inst. for Cancer Research, Oslo). Hereditas, 48: 123-31(1962).

Male flies were either irradiated with 1000 r or fed a sugar solution containing P^{32}. The latter flies attained an average activity of 75 $\mu\mu$C. The males were immediately mated with unirradiated females according to the brood pattern technique. Chromosomal aberrations (deletions, translocations, and inversions) were recovered following treatment with either mutagen. The distribution of point mutation lethals induced on the X chromosome by P^{32} was identical to the one found after x-ray treatment. The highest frequency of sex-linked recessive lethals in the P^{32} series was found on days 7 and 8, as compared with day 5 for the x-ray series. The sterile period in the x-ray series following the exhaustive mating system used may be attributed partially to dominant lethals, lack of functional sperm, and to meiotic or mitotic inhibition due to irradiation. P^{32} incorporated into the DNA of mature sperm was recovered 7 to 8 days after a single meal, under conditions of excessive mating, which coincides with maximum genetic effect. Thus the results favor the concept that the period of maximum DNA synthesis corresponds to the period of maximum lethal induction and/or of chromosome breakage. (H.H.D.)

21517 MICRONECROTIC FOCI IN THE SPLEEN OF IRRADIATED ANIMALS. V. A. Sondak, M. N. Meissel, and V. M. Manteufel (Inst. of Radiation and Physico-Chemical Biology, Academy of Sciences, USSR and Inst. of Biophysics, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol., No. 2, 232-9(1963). (In Russian)

Intravitam and supravitam luminescent-microscopic studies of spleen preparation from irradiated animals distinctly demonstrate both early and late injuries of the cells of this organ. These injuries, at first very delicate and then more drastic, are to be detected both in individual cells and in groups of closely adjacent cells forming characteristic foci. The major component of these foci are lymphocytes. The number of micronecrotic foci in the spleen increases with increase in the radiation dose, and at a 500 r dose it reaches the maximum on the 12th hour following irradiation. Injured lymphoid cells, their decomposition products, and micronecrotic foci exhibit increased luminescence in the ultraviolet range of the spectrum. Since a similar effect has been recorded in myeloid cells of bone-marrow it appears highly probable that the increase in ultraviolet luminescence depends on biochemical changes of the irradiated cells. (auth)

21518 ANTIBODY FORMATION. IV. FORMATION OF RAPIDLY AND SLOWLY SEDIMENTING ANTIBODIES AND IMMUNOLOGICAL MEMORY TO BACTERIOPHAGE ϕX 174. Jonathan W. Uhr and Martin S. Finkelstein (New York Univ., New York). J. Exptl. Med., 117: 457-77 (Mar. 1, 1963).

Bacteriophage ϕX 174 injected into guinea pigs resulted in the formation of rapidly sedimenting antibody molecules (19S), and later, slowly sedimenting molecules (7S). Synthesis of 19S after injection of 10^{10} ϕX virtually ceased at 10 days, after which 19S antibody activity disappears from the circulation with a half life of ~24 hr. A second injection of ϕX on day 5 or 9 prolonged 19S synthesis, indicating that antigen not only can regulate the relative rate, but also is essential for continued synthesis of 19S. The possibility that the antibody-synthesizing mechanism is relatively susceptible to ionizing radiation was investigated. Rabbits were immunized with 10^{10} ϕX and 24 hr later received 400 r whole-body x irradiation. At 1 week, 19S anti-ϕX formation was similar in unirradiated controls and in animals receiving ϕX prior to irradiation. However, at 2 to 4 weeks, 5 of 8 animals in the latter group were continuing to produce large amounts of 19S. By comparison with the unirradiated controls, the onset of the primary 7S response did not appear to be delayed in the group receiving ϕX before irradiation; indeed, larger amounts of 7S were formed. The group irradiated before injection of ϕX developed only trace amounts of anti-ϕX, as expected. Thus, x irradiation after immunization did not prevent the primary 7S response. The results suggest that formation of 19S does not lead to persisting immunological memory. (TCO)

21519 PHENOTYPIC EXPRESSION OF ISOANTIGENS OF THE H-2 SYSTEM IN EMBRYONIC AND NEWBORN MICE. Goeran Moeller (Karolinska Inst., Stockholm). J. Immunol., 90: 271-9(Feb. 1963).

It was demonstrated that the difference in timing with regard to phenotypic expression of various H-2 components in newborn mice was preserved when they were brought together on the same F_1 hybrid erythrocytes or spleen cells. It was shown by the indirect fluorescent antibody technique that H-2 antigens were present on all spleen cells of newborn mice, but the frequency of positively stained cells diminished rapidly with decreasing age in embryos and no antigenic cells could be detected in 15-day-old embryos. X-irradiated (10000 r) cells of 13- to 14-day-old embryos were found to be antigenic, as judged by their capacity to induce transplantation immunity against skin grafts and by their ability to stimulate the formation of humoral antibodies. It is suggested that the difference with regard to the time of phenotypic expression of H-2 isoantigens as shown by various techniques is due to differences in the relative sensitivity of the methods used rather than to differences in the kind of isoantigens detected by the different techniques. (TCO)

21520 IRRADIATION AND TISSUE IMMUNITY. II. RESPONSE TO INJECTION OF STAPHYLOCOCCI IN X IRRADIATED SKIN AREAS OF RABBITS. Reuben L. Kahn (Univ. of Michigan, Ann Arbor). J. Infect. Diseases, 110: 107-13(Mar.-Apr. 1963).

Twenty-four hrs after 1000-r x irradiation of a small area of the skin of rabbits, they were injected with a suspension of staphylococci subcutaneously in the irradiated area and in a nonirradiated control area. Localized lesions were most marked in nonirradiated areas and in some animals no visible lesions were noted in irradiated areas. The mild inflammatory lesions in irradiated areas corrobo-

rate the point of view that irradiation is anti-inflammatory. The reason for mild lesions must be the reduced localization of staphylococci in irradiated areas and their escape from those areas. It is suggested that the antilocalizing property of irradiation is probably the basis for the anti-inflammatory action. When the concentration of organisms injected in the irradiated area was high (10 billion), septicemia and death of the rabbits occurred, presumably as a result of the antilocalizing property of irradiation, which permitted the escape of the organisms from the injected area. In animals injected in irradiated areas with either 0.5 or 5 billion organisms, no septicemia was observed, presumably because of the high natural immunity of rabbits to staphylococci. (TCO)

21521 CARCINOMA OF THE THYROID FOLLOWING X-RAY THERAPY IN INFANCY. John M. Holt (St. Francis Hospital, Wichita, Kansas). J. Kansas Med. Soc., 63: 21-4 (Jan. 1962).

Three new cases of thyroid cancer in children following irradiation are described in detail. Whether the thymus gland plays any role in the production of thyroid neoplasms is unknown, and many cases have been reported in which there was no evidence of thymic enlargement. Most theories center around the relation between the pituitary and thyroid glands. During adolescence there is an increased demand for thyroid hormone and thus an increased amount of thyroid-stimulating hormone, which may be a factor, since the thyroid gland of children seems more susceptible to the carcinogenic effect of x ray. In the 3 new cases of thyroid cancer reported, occurring in 2 19-yr-old girls and a 17-yr-old boy, only the latter had a positive history of previous x ray therapy. He had received 5 x-ray treatments shortly after birth for an enlarged thymus, as did 2 of his now healthy siblings. In 2 cases there were no data available as to whether or not they had received x-ray therapy. It is suggested that indiscriminate use of x-ray therapy for the treatment of benign lesions of the head and neck should be avoided. (TCO)

21522 THYROID NEOPLASMS IN SHEEP FED RADIOIODINE. Sidney Marks and Leo K. Bustad (General Electric Co., Richland, Wash.). J. Natl. Cancer Inst., 30: 661-73(Oct. 1962).

The development is reported of thyroid adenomas in 11 sheep 4 to 8 years old, fed daily quantities of I^{131} ranging from 1.5 to 135 μc. The occurrence of adenomas in 4 sheep and a fibrosarcoma in a fifth was previously reported. This gives an incidence of 16 animals with thyroid neoplasms out of 19 treated. Exposure to I^{131} was either continuous from conception or initiated at an age of 15 months. The radiation doses to the thyroid glands were estimated to range from 7000 to over 100,000 rad for the affected animals. Thyroid adenomas in control sheep were limited to animals 10 years of age or older but were identical in appearance to those of the experimental animals. The histologic characteristics of the adenomas are described. (auth)

21523 RADIATION RESPONSE OF MAMMALIAN CELLS GROWN IN CULTURE. IV. DOSE DEPENDENCE OF DIVISION DELAY AND POSTIRRADIATION GROWTH OF SURVIVING AND NONSURVIVING CHINESE HAMSTER CELLS. M. M. Elkind, Antun Han, and Kathleen W. Volz (National Cancer Inst., Bethesda, Md.). J. Natl. Cancer Inst., 30: 705-21(Oct. 1963).

Using an established line of Chinese hamster cells and 55 kv x rays, the postirradiation growth kinetics of initially log-phase cells after acute x-ray exposures were studied. The division delays for surviving and nonsurviving cells were essentially equal and linearly dependent on dose; the initial post-delay growth rates of the surviving and nonsurviving moieties were close to those of unirradiated cells; and the number of divisions of which nonsurviving cells are capable varied approximately inversely with dose. Several deductions were made from these results. After moderate to large doses, survival is a much more sensitive indicator of radiation damage than division delay; metabolic processes responsible for growth and division may be interrupted but are largely unimpaired by doses producing significant division delays and lethal effects; and ascribing division delay to a mitotic block, which could be expected to lead to synchronous post-delay growth, is not indicated since asynchronous growth was observed. These results are discussed in the context of possible lethal mechanisms of ionizing radiations. (auth)

21524 EFFECTS OF MASSIVE X-IRRADIATION ON RAT ELECTROENCEPHALOGRAMS AND BRAIN SEROTONIN. Louise B. Speck (Univ. of Colorado, Denver). J. Neurochem., 9: 573-4(Nov.-Dec. 1962).

Electroencephalograms and brain serotonin levels were studied during and after massive doses of whole body x irradiation. Decreased serotonin levels were found immediately after exposure to 9000/r and 18 hr after 4500/r coinciding with EEG slowing and lethargy. Later, serotonin levels returned to normal even when some of the animals showed severe delayed radiation sickness. (auth)

21525 OBSERVATIONS ON THOROTRAST DEPOSITS IN THE AREA OF THE KIDNEY. H. Kuntzen (Chirurgische Universitätsklinik, Jena, Ger.). Klin. Med. (Vienna), 16: 181-3(Apr. 1961).

Hazards resulting from the use of thorotrast are described. The latent period for tumor development in humans is 20 to 30 yr. Two cases of tumorigenesis following intravascular or intravesicular injections of Thorotrast are described. In the first case Thorotrast had been used to study an aortic occlusion; 13 yr later, examination revealed a thorotrastoma in the renal area, near the aorta, which resulted in constriction of the ureter and incipient hydronephrosis. Microscopically, Thorotrast could be demonstrated in the tumor as a dark pigment surrounded by connective tissue. Some of the pigment was present in macrophages and some was extracellular, in the ground substance. In the second case a transvesicular pyelogram had been carried out to investigate a traumatically ruptured kidney 6 yr earlier. Thorotrast had passed through the rupture site and become deposited around the kidney. This had caused peri- and subcapsular fibrosis, which compressed the kidney, resulting in a painful pyelonephritis. The kidney, which was removed with the thorotrastoma, showed almost complete loss of parenchymal tissue. Development of the benign fibromas in these 2 cases could be attributed to the irritant and radiation effects of ThO_2 on the tissues. (TCO)

21526 HISTOGENESIS OF THE PLASMACELLULAR REACTION IN THE SPLEEN DURING PRIMARY ANTIBODY RESPONSE IN NORMAL AND SUBLETHALLY X-IRRADIATED RABBITS. H. L. Langevoort, F. J. Keuning, J. v. d. Meer, P. Nieuwenhuis, and P. Oudendijk (Universiteit, Groningen, Netherlands). Koninkl. Ned. Akad. Wetenschap., Proc., Ser. C, 64: 397-404(1961).

As early as 5 hr after 500-r whole-body x irradiation, profound damage was found in the splenic follicles. Follicular lymphocytes and marginal-zone cells were nearly quantitatively destroyed, leaving the follicles as circumscript foci of degeneration. The radiation damage appears to have been inflicted almost instantaneously as the cellular debris had already been largely phagocytized by reticular

cells. At 24 hr after irradiation the debris of follicular lymphocytes had been digested, leaving the follicles as small, pale staining areas of reticular cells; the sheath lymphocytes had largely survived. During the following days the follicular remnants gradually disappeared; the periarteriolar lymphocyte sheaths were left as the only constituent of the white pulp. Lymphocyte numbers increased slightly from the 5th day onwards. By the 10th day the first signs of follicular recovery were seen. A remarkable observation was the appearance of numerous mature plasma cells in the periarteriolar lymphocyte sheaths from the 2nd day on. Serologic data in rabbits immunized with paratyphoid B H-antigen showed a depression of peak titer values only in animals receiving irradiation 24 hr before antigen. The induction period was only slightly lengthened in the animals receiving antigen 12 hr before, immediately before, and immediately after irradiation; considerable lengthening was found in those receiving antigen 12 hr and 24 hr after irradiation. It was concluded that antibody production is not depressed if antigen is given immediately before or after sublethal irradiation and that a plasma cell reaction develops in the surviving lymphocyte sheaths under these conditions. (TCO)

21527 ANTIBODY PRODUCTION BY IMMUNOLOGICALLY COMPETENT CELLS TRANSFERRED TO A HETEROLOGOUS HOST. Avinoam Zlotnick (Hasassah Univ. Hospital, Jerusalem). Lab. Invest., 12: 306-15(Feb. 1963).

When lymph node cells from rabbits sensitized with bovine serum albumin (BSA) or bovine serum γ-globulin (BGG) were restimulated in vitro with homologous antigens and transferred to the cheek pouch of x-irradiated (450 r) hamsters, they produced specific antibody in the recipients. The antibody produced in the hamsters is identical with rabbit γ-globulin. Specific changes in the morphology of the transferred cells during the process of antibody production in the heterologous host are described. Changes in the population from small lymphocytes to large mononuclear cells and subsequent differentiation either into plasma cells or into small and medium-sized lymphocytes were noted. Mitotic indexes determined daily after injection of colchicine showed a low mitotic activity on the first 2 days after transfer and increased activity on the third and fourth days after transfer. It is postulated that some of the cells enlarge, divide, and differentiate into cells that contain anti-BSA or anti-BGG as a result of the antigenic stimulus with BSA or BGG, and that others enlarge, divide, and differentiate into cells that contain antibody to the host constituents that are foreign to these cells. (TCO)

21528 VARIATION IN METABOLISM IN HEPATIC TISSUE AFTER WHOLE-BODY EXPOSURE TO LETHAL RADIATION DOSES. V. Ricotti and A. Notario (Università, Pavia, Italy). Minerva Nucl., 7: 18-32(Jan.-Feb. 1963). (In Italian)

A study has been made of the behavior of nucleated blood cells in peripheral blood, mortality curves, and the hepatic utilization of glucose-U-C^{14}, acetate-1-C^{14}, and cysteine-S^{35} in the normal mouse, and in the mouse irradiated with lethal doses of x rays, and in the mouse irradiated before and after intraperitoneal inoculation of small quantities of physiological solution designed to increase tissue hydration. The findings showed that mortality begins from the 4th day following irradiation and overcomes all the mice towards the 12th day. There is a marked fall in the leucocytes of peripheral blood, which is particularly early in the mice in whom sterile physiological solution had been injected intraperitoneally before irradiation. The hepatic utilization of the labeled glucose and acetate in the irradiated animals was constantly increased during the first 3 to 4 days following irradiation in all the groups studied, and only at a later stage tended to fall to normal or slightly below normal levels. The maximum C^{14} uptake occurred at the level of CO_2 and to a lesser or equal extent in the normal animals at the level of the lipid and non-lipid cellular components. The utilization of labeled cysteine was also increased in the first few days following irradiation, but subsequently returned to normal. The distribution of radioactivity in this case showed that maximum increase occurred in the first few days at the expense of protein and polypeptide synthesis, while only at a later stage, when protein synthesis was reduced, did inorganic sulfur radioactivity rise above the level of that found in the control animals. An over-all interpretation of the results suggests that irradiation stimulates oxidation processes, a stimulation which, in the case of protein metabolism, is preceded by a short period of increased protein synthesis. (auth)

21529 STUDY OF ULTRASTRUCTURAL CYTOPLASMIC CHANGES IN THE IRRADIATED LIVER CELL. Giuseppe Poggi Longostrevi and Luciano Lombardi (Università, Milan and Istituto di Radiologia dell'Ospedale Maggiore, Milan). Minerva Nucl., 7: 51-74(Jan.-Feb. 1963). (In Italian)

A study has been made of the behavior of hepatic cytoplasmic ultramicroscopic structures in rats after irradiation of the hepatogastric region with a single dose of 800 r, the animals being killed after 1 hour, 12 hours, 2.5 days, 1 week, 2 weeks, 1.5 months, and 2 months; and after total irradiation with graded doses of 100 r, 200 r, 400 r, and 800 r, the animals being killed 1 day, 10 days, or 30 days after irradiation. After local irradiation there was seen a picture of morphological changes (swelling of the ergastoplasm, mitochondria, and Golgi's apparatus) which then regressed, and, after a weeks interval, there were seen new changes which repeat and emphasize the original ones and which partially persist up to two month's time. A noteworthy appearance of osmiophilic granules was observed in the vescicles of Golgi's apparatus, as well as their close topographic relationship to lysosomes, whose structure was atypical with rarefaction of the matrix. Following total irradiation, hypertrophy of the ergastoplasm occurred within a day, followed by regressive changes of the same. (auth)

21530 FATE OF TRITIATED NATIVE LIVER DEOXYRIBONUCLEIC ACID INJECTED INTO LETHALLY IRRADIATED RATS. A. Popović (Inst. of Nuclear Sciences "Boris Kidrich," Belgrad), A. Bečarević, D. Kanazir, N. Stošić, and V. Pantić. Nature, 198: 165-7(Apr. 13, 1963).

The fate of native homologous liver tritiated desoxyribonucleic acid (DNA) was followed by means of radioautographic techniques after injection into lethally irradiated rats. Results indicate the incorporation of the tritiated DNA into the nuclei of some cells of the testes, intestines, spleen, and liver of irradiated recipients. The macrophages appeared to be involved in the transport of injected DNA. Metabolism of the liver nucleic acid of irradiated DNA-treated animals appeared to return almost to normal. (C.H.)

21531 SERUM HAEMAGGLUTININS IN HETEROLOGOUS CHIMAERAS. E. M. Uyeki (General Electric Co., Richland, Wash.). Nature, 198: 196-7(Apr. 13, 1963).

Graft anti-host and host anti-graft antibodies were demonstrated in the sera of mouse heterologous radiation chimeras 3 to 4 weeks after treatment. The specificity of the antibodies is discussed. (C.H.)

21532 A FAST-NEUTRON SOURCE FOR RADIOTHERAPY. P. D. Lomer (Services Electronics Research Lab.,

Baldock, Herts, Eng.) and D. Greene. Nature, 198: 200-1 (Apr. 13, 1963).

The possibility of developing a simple and compact fast neutron source for radiotherapy is discussed. Results of preliminary studies on applications of the D-T reaction, $H^3(d,n)He^4$, as a source of 14-Mev neutrons indicate that sealed neutron tubes may be made that give radiation of comparable penetrating power to megavoltage x rays. (C.H.)

21533 RELATIONSHIP BETWEEN CHROMOSOME NUMBER AND RADIOSENSITIVITY OF TUMOUR CELLS. László Révész, Ulla Glas, and Goeran Hilding (Karolinska Inst. Medical School, Stockholm). Nature, 198: 260-1 (Apr. 20, 1963).

The relation between chromosome number and radiosensitivity of tumor cells was investigated in a series of tumor cell clones of common origin studied under uniform experimental conditions. Results indicate that there is no consistent relationship between chromosome number and radiosensitivity. (C.H.)

21534 EFFECT OF OXYGEN IN MAMMALIAN CELLS SENSITIZED TO RADIATION BY INCORPORATION OF 5-BROMODEOXYURIDINE INTO THE DNA. R. M. Humphrey, W. C. Dewey, and A. Cork (Univ. of Texas, Houston). Nature, 198: 268-9(Apr. 20, 1963).

The effect of oxygen on sensitivity to x radiation was measured in mouse fibroblast cells growing in culture after sensitization of the cells to radiation by incorporation of 5-bromodesoxyuridine into the desoxyribonucleic acid. The radiosensitivity of cells irradiated in oxygen and in nitrogen was approximately the same. (C.H.)

21535 TRANSIENT SENSITIVITY OF INTRACELLULAR PSITTACOSIS VIRUS TO X-RAYS. Morris Pollard, Nehama Sharon, and W. R. Klemm (Univ. of Notre Dame, Ind.). Nature, 198: 313-14(Apr. 20, 1963).

Members of the psittacosis virus group of microorganisms replicate through a series of cytochemically defined reactions, as visualized by fluorescence microscopy of infected cells stained with acridine orange. Procedures are described for examining radiation effects in these organisms. It is pointed out that the system provides a dynamic, intracellular, cytochemical indicator system with which quantitative dose-response relationships can be studied. Results are presented from studies on radiation effects on active virus in tissue cultured cells and control preparations. The effects of x rays on intracellular virus suggests that it was an irreversible reaction. During the sensitive stage of replication the logarithm of the survival ratio was proportional to the dose of x rays, except for a deviation shown at 6,000 r. Response of the virus to irradiation was more decisive than that of the host cell. It is postulated that the effect of x-ray treatment was on the initial viral desoxyribonucleic acid. (C.H.)

21536 SPECIAL-PURPOSE SLIDE RULES AS EXEMPLIFIED BY A RULE FOR MAINTAINING A CONSTANT EXPOSURE IN SUCCESSIVE AUTORADIOGRAPHS WITH IODINE-131. Ellery C. Stowell (Veterans Administration Hospital, Long Beach, Calif. and Univ. of Southern California, Los Angeles). Nature, 198: 318(Apr. 20, 1963).

The design is reported of a plastic slide rule for determining I^{131} radioautograph exposure schedules when the initial exposure period is 24 hours. Modifications can be introduced to suit different objectives. (C.H.)

21537 EFFECT OF IONIZING RADIATION ON LIPID METABOLISM IN BLOOD CELLS IN VITRO. B. Malamos (Univ. of Athens), C. Miras, and J. Meade. Nature, 198: 401-2(Apr. 27, 1963).

The incorporation of acetate-C^{14} into the lipids of leukocytes and blood platelets was not affected by irradiation when the cells were suspended in NaCl. (C.H.)

21538 SARCOMA OF THE SKELETON, CAUSED BY INTENSIVE ROENTGEN IRRADIATION. J. A. van Dongen, G. Montanari, and E. A. van Slooten (Nederlands Kankerinstituut, Amsterdam). Ned. Tijdschr. Geneesk., 105: 128-34(June 1961).

Case histories are described relating to 5 patients who developed sarcomas of bone following radiotherapy, and a survey was made of 60 similar cases. In 4 of the 5 cases described in detail, the estimated total radiation doses were 4500, 7290, 2400, and 3400 r. The intervals between radiotherapy and recognition of sarcoma in the 5 cases were 4, 8, 8, 12, and 15 yr. Histologically such bone tumors had the structure of osteosarcoma or fibrosarcoma, even though no marked development of bony or fibrous tissue may be apparent. In 40% of the reported cases, x-ray therapy had been given for benign conditions of the bone. In all other cases treatment had not been directed at changes in the skeletal structures, but sarcoma had developed later in bony parts within the region that had been irradiated for malignant processes, generally with high x-ray doses. The increasing use of intensive x-ray therapy in recent years will probably result in the higher incidence of osteogenic sarcomas in future decades. (H.H.D.)

21539 ANOMALOUS COURSE OF THERMAL DENATURATION OF DEOXYRIBONUCLEIC ACIDS FROM LEUKEMIC AND IRRADIATED ANIMALS. Z. Šormová and F. Šorm (Inst. of Organic Chemistry and Biochemistry, Czechoslovak Academy of Science, Prague). Neoplasma, 8: 619-20(1961). (In English)

DNA from leukemic mouse spleen (postradiation leukemia) exhibits, after treatment with trichlorotriethylamine, a different course of thermal denaturation compared with DNA from normal animals treated with the same reagent. With DNA from normal organs, the alkylating agent caused only a small decrease of denaturation temperature (T_m), but with pathologic DNA a 15 to 20% decrease of hyperchromic effect was observed. A similar anomalous course of thermal denaturation was observed with DNA preparations isolated from thymus and spleen of rats treated with x rays. The organs were obtained 2 hr after irradiation with 600 r and DNA was isolated. All DNA preparations treated with trichlorotriethylamine showed a decreased T_m compared with control samples. Control preparations of DNA from rat thymus had a T_m of 91.5–92.5°, from spleen 90–91°. The samples treated with trichlorotriethylamine showed various values according to the DNA used; thus, with freshly prepared samples, the T_m decrease was about 2° for thymus and about 4° for spleen. DNA isolated from the tissues of irradiated animals showed, after treatment with trichlorotriethylamine, lower hyperchromicity during thermal denaturation (decrease of absorbance of about 10%) compared with control DNA. This suggests that transformation of a normal cell into a leukemic one may be due to a specific change of secondary DNA structure caused by radiation. (TCO)

21540 THYROID CARCINOMA IN MAN AFTER EXPOSURE TO IONIZING RADIATION: A SUMMARY OF THE FINDINGS IN HIROSHIMA AND NAGASAKI. Edward L. Socolow, A. Hashizume, S. Neriishi, and R. Niitani (Atomic Bomb Casualty Commission, Hiroshima and Nagasaki). New Engl. J. Med., 268: 406-10(Feb. 21, 1963).

A survey was made of thyroid carcinoma incidence detected during a 3-yr period in the populations of Hiroshima and Nagasaki to determine whether a relation exists be-

tween previous exposure to ionizing radiation and the subsequent development of thyroid carcinoma. All cases were found during routine medical examinations of matched groups of exposed and nonexposed subjects. The data presented for 20000 subjects strongly suggest that there is a highly significant correlation between proximal exposure to the radiation of atomic weapons and the eventual development of thyroid carcinoma. Of 355 patients found to have enlarged thyroid glands in Hiroshima and Nagasaki, 21 patients with histologically confirmed thyroid carcinoma were seen. If patients are grouped according to distance from the hypocenter, a significant increase in the prevalence of thyroid carcinoma is seen among those more heavily irradiated, with 14 of 21 cases occurring within 1399 m. The distribution of the Hiroshima cases is highly significant, and analysis of the data for both cities combined shows a prevalence of thyroid carcinoma among the more heavily exposed that is also highly significant. (TCO)

21541 SOME ASPECTS OF THE DEGENERATION AND DEATH OF CELLS UNDER THE ACTION OF RADIATION. M. N. Meissel, G. A. Medvedeva, and M. N. Poglazova (Inst. of Microbiology, Moscow). Pathol. Biol. Semaine Hop., 9: 839-41(Apr. 1961).

Biochemical and cytologic changes were investigated in yeast cells (Saccharomyces cerevisiae, Saccharomycodes ludwigii, Endomyces magnusii) exposed to Co^{60} γ radiation at a dose rate of 90 r/sec. The cells in aqueous suspensions were given doses up to 1 Mrad. Threshold doses of the radiosensitivity of various cellular functions are given. The cells show a sharp rise in mortality rate at doses above 500000 rad. The death of cells is accompanied by visible changes in nuclei and mitochondria, increased uptake of the fluorescent dye aminoacridine, appearance of autofluorescence in the visible spectrum, liberation of RNA, and granulation of cytoplasm. Mitochondrial injury begins to appear after doses of 300000 to 350000 rad as seen by fragmentation, but functional changes, such as impaired oxidative phosphorylation, occur after much lower doses. When the cells are not immediately killed by radiation, disorganization of cellular function and structure occurs in the order: impairment of cellular and nuclear division; disorganization of the nuclear genetic apparatus; failure in the ability of the nucleus to regulate cell metabolism; inability of mitochondria to carry out synthesis of energy metabolites and other essential metabolic functions; and alteration of the function of endoplasmic reticulum, presumably secondary to failure in nuclear control and mitochondrial function. It therefore appears that, depending upon the amount of radiation absorbed, the cell may undergo reversible changes in function, of which those of the nucleus are most sensitive. (TCO)

21542 A MICROCINEMATOGRAPHY METHOD IN THE INVESTIGATION OF THE EFFECT OF X RAYS ON CELLS. A. F. Ivanitskaya (Inst. of Animal Morphology, Moscow). Pathol. Biol. Semaine Hop., 9: 842-3(Apr. 1961).

Time-lapse microphotographs were taken of hematopoietic cells of mice and Ambystoma mexicanum after lethal whole-body doses (1000 and 2000 r, respectively) of x radiation. The cells were examined in cultures taken at various intervals postexposure. Cultured cells from spleen and liver showed diminished ameboid movement after irradiation and the impairment was more marked the later the cells were explanted from the irradiated organs. The cells with impaired motility show granular cytoplasms, they have diminished phagocytic activity when tested with bacteria (Caryophanon latum), and their longevity is considerably diminished. Lymphoid cells appear only in cultures taken soon after irradiation and show reduced viability, their nuclei becoming pyknotic and chromatin homogenized. Granulocytes were found in cultures obtained later, but their longevity was also reduced. Macrophages and fibroblasts showed more resistance to radiation. However, irradiated macrophages did give rise to multinucleated giant cells, particularly when explanted from axolotal spleen. The sensitivity of hematopoietic cells appeared to be directly related to their nuclear/cytoplasmic ratio, plasma cells having the largest nuclear volume and being the most sensitive. The latter cells apparently perish as a result of nuclear changes, whereas macrophages, with a low nuclear/cytoplasmic ratio, die primarily from changes in cytoplasm. (H.H.D.)

21543 STUDIES ON THE LYMPHOID TISSUE OF HEMATOLOGIC RADIOCHIMERAS. G. Mathé and J. L. Amiel (Hôpital Saint-Louis, Paris). Pathol. Biol. Semaine Hop., 9: 894-901(Apr. 1961).

Repletion of lymphoid elements was studied in radiochimeras restored with immunologically compatible and incompatible hematopoietic cells. Repletion was rapid and complete in isogenic chimeras (F_1 C57B16 × DBA/2), which had been irradiated with 750 r and injected with bone marrow or a mixture of bone marrow and lymph node cells. However, restoration with allogenic cells (C57B16 irradiated mice injected with DBA/2 cells), when it resulted in repletion of myeloid elements, was followed by the secondary syndrome, with lymphopenia and lymphoid aplasia. Development of the syndrome was most rapid in animals receiving allogenic lymphoid cells. Studies with animals previously immunized with bacterial antigens showed that immunologic memory was retained in isogenic radiochimeras but lost in allogenic chimeras. Aplasia of the lymphoid tissue of the chimeras is thus the result of immunologic activity of the graft against the host, in addition to the irradiation injury of lymphoid cells. Pronounced restoration was obtained in F_1 hybrids irradiated and injected with marrow and lymph cells of the parental strains. Serum γ-globulin levels are regenerated more rapidly in allogenic chimeras. However, a secondary hypogammaglobulinemia develops in the allogenic chimeras when the graft anti-host reaction destroys the lymphoid tissue. The incidence of the secondary syndrome after restoration with embryonic hematopoietic cells was as great as when the cells of adult incompatible donors were used. (TCO)

21544 PRELIMINARY RESULTS OF AN EXPERIMENTAL STUDY OF PULMONARY RADIOTHERAPY IN THE GUINEA PIG. M. L. Chevrel, A. Danrigal, R. Raveleau, J. L. Richier, M. Louvet, and J. Guelfi (Centre Régional de Lutte Contre le Cancer, Rennes, France). Pathol. Biol. Semaine Hop., 11: 189-94(Feb. 1963).

Radiologic and histologic lesions in the lungs of guinea pigs were followed after exposure to γ and x-ray doses comparable with those used in human radiotherapy. Co^{60} γ radiation was applied in skin doses of 200 r per session, in 2 sessions per week, to give total surface doses of 1800 to 5000 r and depth doses of 1350 to 5000 r. With 200-kv x rays, skin doses of 100 r, 2 to 3 times weekly, were given to total surface doses of 600 to 1800 r and depth doses of 360 to 1800 r. Some animals were given daily injections of corticosteroid hormones throughout radiation treatments, and the lungs were examined up to 6 to 7 months after completion of the treatments. Lesions observed radiologically were generally mild and consisted of discrete opacities throughout the lung perenchyma. They first appeared after ~18 sessions and reached maximum intensity after 30 sessions. The lesions were of 2 types, one appearing 6 to

10 days after irradiation and the other after a longer (>3-month) latent period. Macroscopically, the irradiated lung appeared congested and edematous, and the first histologic lesions appeared to involve the blood vessels. (TCO)

21545 ANATOMIC AND HISTOLOGIC STUDY OF THE LESIONS INDUCED BY ROENTGEN IRRADIATION AND ROENTGEN PLUS RADAR WAVES ON THE SKIN AND PRINCIPAL VISCERAL ORGANS (LIVER, SPLEEN, KIDNEY, AND ADRENAL). G. Cavallero, E. Balestra, and E. Pignataro (Università, Genoa and Ospedali Civili di Genoa Sampierdarena, Genoa). Pathologica, 54: 175-86 (July-Aug. 1962).

Three groups of guinea pigs were submitted to different x-ray treatments, and half the animals in each group were additionally submitted to radar waves. The 1st group received a single epilating (3000-r) dose of x rays (60-kv) in the abdominal region; the other 2 groups received whole-body 400- or 800-r doses of 200-kv x rays. Eight radar sessions per day were given, each lasting 15 min. In general, radar treatment aggravated the effect of x irradiation. In the skin examined 12 days after 3000-r x irradiation, radar accentuated the hyperkeratosis, atrophy of hair bulbs, pyknosis of epithelial cells, and degenerative changes in extracellular constituents as seen by the periodic acid-Schiff (PAS) reaction. In the 2nd group (400-r), only 2 of 20 x-irradiated guinea pigs died by the 20th day in contrast to 100% 20-day mortality seen in animals exposed to radar. Liver pathology was the most severe in the radar-exposed subgroup. The spleen, kidney, and adrenal cortex were also affected. Most of the pathological changes were not seen or were much milder in guinea pigs receiving only x irradiation. The changes were most marked in those exposed to 800 r plus radar. In this subgroup, all animals died by the 15th postirradiation day, whereas after 800 r alone, the mortality was 70% at this time. It was concluded that radar waves accentuate the tissue injury caused by ionizing radiation. (TCO)

21546 PRESENT STATUS OF BONE MARROW TRANSPLANTATION. Joseph W. Ferrebee and E. Donnall Thomas (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Pediat. Clin. North Am., 9: 851-3(Aug. 1962).

The transplantation of isogenic and allogenic human bone marrow cells in efforts to re-establish marrow function in patients whose marrow has been destroyed by disease, radiation, or chemotherapy is reviewed. (TCO)

21547 CHROMOSOMAL ABERRATION IN AN INFANT FOLLOWING THE USE OF DIAGNOSTIC X RAYS. P. E. Conen, A. G. Bell, and N. Aspin (Hospital for Sick Children, Toronto). Pediatrics, 31: 72-9(Jan. 1963).

A 6-week-old infant with multiple congenital defects was submitted to x-ray diagnostic procedures, which resulted in an estimated 820-millirad exposure of the hematopoietic system. A study of chromosomes in leukocyte cultures subsequently revealed chromosome aberrations that appeared to be attributable to ionizing radiation rather than abnormal congenital karyotypes. Of 121 cells analyzed, 28 showed chromosome aberrations. Excluding the 28 cells containing aberrations, karyotypes prepared from suitable cells showed the chromosome complements of a normal female. Two main types of aberrations following irradiation are described, 1 involving only 1 of the 2 chromatids that form a dividing metaphase chromosome. The possibility cannot be excluded that the disease state of the child may be the cause of chromosome aberrations similar to those induced by radiation. It is also possible that submicroscopic chromosomal defects were present in this infant related to the malformations present and that the defects increased the sensitivity of the cells to the small x-ray dose given. It was concluded that very small doses of ionizing radiation may in some cases produce chromosome abnormalities detectable in peripheral blood cultures. It is suggested that roentgenographic examinations in infants should be kept to a minimum and only the most necessary studies performed. (TCO)

21548 THE INFLUENCE OF EXTERNAL IRRADIATION ON THE DENSITY OF THE BLOOD SERUM IN RATS. M. Rakovic and Z. Dienstbier (Charles Univ., Prague). Physiol. Bohemoslov., 10: 461-6(1961).

Serum density changes were investigated in rats exposed to 600-r, whole-body x irradiation, and compared with those in rats with skin burns and in dehydrated rats. Serum density rose after irradiation, to a maximum of 1.0273 at the 6th hr, from an initial value of 1.0244. The density was still elevated 48 hr postirradiation. The results were obtained with serum stored at 4°C for 24 hr after collection of blood. Less pronounced changes were obtained with fresh serum or serum incubated at 37°. Serum did not show a similar change in density after burns or dehydration, indicating that nonspecific stress after irradiation was not responsible for the change. It is suggested that the rise in density caused by irradiation may be due to some substance released by irradiated tissues into blood, possibly DNA or RNA constituents. (H.H.D.)

21549 GENETIC EFFECTS OF SPACEFLIGHT FACTORS. Ya. L. Glembotskii and G. P. Parfenov. Probl. Kosmich. Biol., 2: 98-114(Dec. 1962).

With the object of investigating effects of spaceflight factors on heredity, Drosophila melanogaster was carried on the second, fourth, and fifth orbital spaceships and on Vostok-1 and Vostok-2. Four different spaceflight effects were investigated. Nondisjunction of chromosomes was investigated by exposing unfertilized white-eyed Drosophila females on Vostoks 1 and 2 and mating them on their return with red-eyed males. Primary nondisjunction of chromosomes resulted in the appearance of four times as many unusual genotypes (XXY females and XO males) among the progeny of the exposed group as among offspring of the controls. However, the increase in nondisjunction cannot be ascribed to radiation effects. Induced crossovers were investigated by exposing heterozygotic males (having normal phenotypes but three recessive genes in the second chromosome) on the fifth orbital spaceship and on Vostoks 1 and 2. Upon return they were mated with homozygotic females displaying the three recessive characteristics (black body, cinnabar eyes, and vestigial wings). Drosophila carried in the fifth orbital spaceship with no protection against low-frequency vibrations showed crossover incidence of 0.50 ± 0.12%, compared to an incidence of 0.05 ± 0.05% or none at all on Vostok spaceships, where the insect containers were cushioned against vibration. Dominant lethal mutations were investigated by exposing two strains of Drosophila melanogaster (D-18 with a high rate of spontaneous lethal mutations, and D-32 with a low rate for the same mutations) of the five spacecraft. The number of dominant lethal mutations was found to increase somewhat in all groups exposed to space flight. Sex-linked recessive lethal mutations were investigated by exposing young males of the D-18 and D-32 strains of Drosophila melanogaster on all five vehicles. Exposure on the second and fourth orbital spaceships and on Vostok-1 resulted in statistically significant numbers of sex-linked recessive lethal mutations for

spermatozoa and spermatids of both strains. However, no increase in mutations was observed following exposure on the fifth orbital spaceship and on Vostok-2. (TCO)

21550 EFFECT OF EXTRATERRESTRIAL RADIATION CONDITIONS ON PLANTS. Yu. L. Sokolov and A. V. Gurskii. Probl. Kosmich. Biol., 2: 164-8(Dec. 1962).

In order to determine the effects of extraterrestrial radiation, plants were grown at altitudes of 4000 to 5000 m. Experiments showed that irradiation of plants with sufficiently large uv doses in the 240 to 270-mμ range is lethal, chiefly because it denatures cell proteins, whose absorption maximum lies near 260 mμ. However, if the entire visible spectrum is added to the extreme uv rays, the vitality of the plants is not impaired. This is due to the process of reactivation, which protects plants against injury from large doses of uv-rays and enables them to adjust to completely unusual conditions of radiation. (TCO)

21551 EFFECT OF RADIATION RATE ON THE NERVOUS SYSTEM. N. N. Lifshits, E. S. Meyzerov, Z. I. Apanasenko, and M. A. Kuznetsova. Probl. Kosmich. Biol., 2: 303-12(Dec. 1962).

The effects of long-term irradiation at a low rate on the central nervous system was compared, in tests with rabbits, to the effects of a single large dose on the protective flection reflex, and in rats on the electric resistance of the cerebral cortex and conditioned reflex activity. Rabbits were exposed to x rays either in single whole-body doses of 400 v or in split doses of 10 r five times per week for eight weeks. No appreciable difference was observed in the effect of the two types of exposure on the latent period of the unconditioned protective flection reflex of the shank. Two groups of rats were exposed to gamma radiation in whole-body doses of 160 r. One group was subjected to chronic (22 hr/day), low doses (~ 6 r per diem) until the total of 160 r was reached; the second group received a single 160 r exposure (at 84 r/min). Changes induced in the central nervous system, as reflected by conditioned reflex activity, were approximately the same. Two groups of rats were exposed to doses of 600 r, the first at the rate of 0.5 r/min and the second at 600.0 r/min. Changes in the electric resistance of the cerebral cortex in the slowly irradiated group were far more marked and lasted four to five days longer than changes in the second group. It was concluded that prolonged irradiation at a low dosage rate has a more profound effect on the functioning of the central nervous system than an equal dose administered at a high rate. (TCO)

21552 TISSUE REACTIONS EXPERIENCED WITH THE THERATRON JUNIOR. H. Holden (Peter MacCallum Clinic, Launceston, Tasmania). Proc. Coll. Radiol. Australasia, 3: 61-6(June 1959).

In 76 cancer patients treated with Co^{60} γ-ray therapy, a study was made of reactions of skin and mucous membranes in correlation with the calculated tissue doses, and the results were compared with those obtained with 250-kv x-ray therapy. For bladder cancer the larger the field size used, the more intense the reaction seen both in rectum and bladder. The rectal reaction is due to the greater overlap of the fields. A mild rectal reaction can be expected after 4500 r over 5 weeks, and a severe reaction if the level is exceeded. Complete tumor regression was seen as an immediate result of treatment. The mucous membrane reaction after irradiation of head and neck cancers was surprisingly mild in view of the high doses delivered in certain cases (6000 to 7000 r in 5 weeks). For opposing fields, the reaction was more severe. It was concluded that with Co^{60} therapy mucous membrane reactions are minimal, except when opposing fields are used. Skin reactions are negligible in most cases. Tissue reactions observed for skin and mucous membrane in various sites were related to the physical dose, calculated from calibration of the equipment. Good agreement was obtained between biological response and the calculated dose. A dual technique, employing both 250-kv x rays and Co^{60} γ rays, is described for treatment of parotid tumors, and was found valuable as an aid to dosimetry. (TCO)

21553 IMPORTANCE OF PARAMETERS—ANGLE OF ROTATION, DEPTH OF FOCUS, WIDTH OF FIELD, IN ROTATIONAL TELECOBALT THERAPY. Raffaello Sighinolfi (Università, Bologna and Ospedale S. Maria Delle Croci, Ravenna, Italy). Radiobiol. Radioterap. Fis. Med., (3) 17: 358-73(Sept.-Oct. 1962). (In Italian)

To apply rotational therapy with Cobalt 60 sources, it is necessary to overcome the difficulties connected with a preliminary knowledge of dosage distribution in the treatment zone, taking into account, during the cycling rotation, the variations of both the source-to-skin distance and of the latter and the seat to be irradiated. With the use of a source of Co^{60} it is necessary, as in normal voltage rotational therapy, to refer to the three parameters: the pendulation angle to be chosen; the determination of the size of the field over the zone of treatment; the exact position of the cycling rotation centre in the section of the body to be irradiated. To this purpose a rather quick method is suggested, that is, use of the calculated diagrams and lists in the text, supplying exact data with slight differences. The eventual photographic dosimetry can give an immediate idea of the shape and position of the more important isodose charts, which nearly approach those obtained by calculation. (auth)

21554 EFFECTS OF HYPOTHEMIA ON RATE OF SURVIVAL OF IRRADIATED RATS. E. Del Vecchio and M. Crocco Egineta (Università, Naples). Radiobiol. Radioterap. Fiz. Med., (3) 17: 401-6(Sept.-Oct. 1962). (In Italian)

It was found that 45% of rats irradiated in the state of hypothermy (rectal temperature of 15 to 16°C) with lethal doses of 800 r survived more than 30 days, whereas all controls died within 16 days. It was concluded that the influence of hypothermy on the mortality of roentgen-irradiated animals is related to the general level of metabolic processes and not only due to anoxia. (auth)

21555 ON THE PROBLEM OF REDUCTION OF THE DOSE IN ROENTGEN-DIAGNOSIS. C. Martinenghi (Ospedale di Circolo di Varese, Italy) and C. Picchio. Radiol. Med., 49: 273-81(Mar. 1963). (In Italian)

The modification of the ratio between the incident dose and the emergent dose by using additional filtration and also by increasing the distance between the source of the radiations, the subject, and the film in diagnostic radiography is discussed. Measurements were made with ionization chambers and comparative radiographic tests were performed in order to determine the correlation between the ionometric data and the values of radiographic blackening. It was demonstrated that a considerable reduction of the incident dose, at equal emergent doses may be obtained, especially in the case of beams of radiation generated under fairly low voltages (from 50 to 60 kv), by using supplementary filtration with 3 to 5 mm of aluminum or else by increasing the source-film distance, without having to subject the radiogenic tube to excessive loads. (auth)

21556 THE EFFECT OF RADIATION ON THE LYMPH AND ON THE LYMPH VESSELS.* M. Lenzi and G. Bassani (Università, Modena, Italy and Università, Parma, Italy). Radiology, 80: 814-17(May 1963). (In English)

Lymph vessels were not sealed by irradiation following a variety of radiation modalities. No difference was noted in the effects of various types of radiation. Implications in the occurrence of lymphatic metastasis in cancer patients are discussed. The destruction of lymph cells was the most conspicuous effect of radiation on circulating lymph. Results are summarized from studies on rabbits, guinea pigs, and 30 human uteri following irradiation and hysterectomy for cancer. (C.H.)

21557 HEMATOLOGIC EVENTS AS DOSIMETERS IN HUMAN TOTAL-BODY IRRADIATION. William McFarland and Howard A. Pearson (National Naval Medical Center, Bethesda, Md.). Radiology, 80: 850-5(May 1963). (In English)

A study of hematologic events in 6 patients following therapeutic total-body gamma irradiation in doses ranging from 225 r to 1,500 r suggests that the rate and degree of depression in blood elements are roughly proportional to the amount of radiation received. The depression in reticulocytes appears to be the most important indicator of severe bone-marrow damage. This observation may prove helpful in the clinical management of radiation injury, since the evidence is provided within a few days of exposure. (auth)

21558 DOSAGE CALCULATIONS FOR OBLIQUE BEAMS OF RADIATION. Lucille A. Du Sault and Jean-Marc Legare (Henry Ford Hospital, Detroit). Radiology, 80: 856-62(May 1963). (In English)

A method of calculating gamma radiation dosage for oblique fields, based on the use of tissue-air ratios, is described. The procedure can also be used to obtain isodose curves with a changed FSD and for the determination of the thickness required for a compensating filter. (auth)

21559 DEPRESSION OF ERYTHROPOIESIS BY LOCAL IRRADIATION OF THE SPLEEN: EXPERIMENTAL STUDY IN THE RABBIT WITH THE AID OF Fe^{59}. P. A. Maurice (Policlinique Universitaire de Médecine, Geneva). Schweiz. Med. Wochschr., 92: 1306-11(Oct. 20, 1962). (In French)

Bone marrow function was followed in rabbits after 300-r x irradiation of the exteriorized spleen. The function was evaluated by reticulocyte counts and the rate of removal of injected Fe^{59} from plasma. Precisely 48 hr after splenic irradiation with 300 r, the circulating reticulocyte count fell sharply to less than 1% as compared with 2.5% in controls. The low count persisted for 24 to 36 hr, and was followed by a rise in the count to above normal levels for about 2 days until the normal level was regained. The changes in reticulocythemia were not seen if the spleen was removed after or before irradiation. In contrast, 500-r whole-body irradiation caused a fall in the count within 36 hr to below 1%, with no rebound. The half time for the disappearance of injected Fe^{59} from plasma was not different from the control value of 80 min when the injection was made immediately after splenic irradiation. However, it was increased to ~125 min when Fe^{59} was injected 60 hr afterwards and ~230 min when Fe^{59} was injected 48 hr after 500-r whole-body irradiation. The rapid, reversible depression of erythopoiesis after splenic irradiation suggests that the irradiated spleen releases a factor, possibly humoral, which inhibits maturation of bone marrow cells. (TCO)

21560 HISTOLOGIC STUDY OF THE SMALL INTESTINE REMOVED BY MEANS OF BIOPSY AFTER RADIATION WITH THERAPEUTIC DOSES. R. De Dominicis (Università, Florence). Sperimentale, 111: 77-96 (Mar.-Apr. 1961)

Histologic observations were made on the mucosa of human small intestine irradiated according to common radiotherapeutic methods. Specimens for biopsy were taken from a loop of intestine, included in the zone of radiation, by means of a modified Crosby's catheter. The postirradiation changes consisted mainly of atrophy of the intestinal villi and glands with a consequent flattening of the intestinal mucosa. Also noted were: marked damage of the caliciform cells, which decrease in number and take on a fusiform appearance; modifications of Paneth cells, which display changes, and a decrease in numbers; alterations of the striated border of the enterocytes, which lose its delimitation from the remaining cytoplasm and becomes irregular and thickened; deformation of the enterocytes; and decrease in the number of mitoses, shortly after treatment and with small x-ray doses. After the highest dose (5000 r), intestinal epithelial elements tended to disappear and be replaced by fibrous tissue. It was evident, however, that much lower doses also altered the functional activity of intestinal mucosa. (TCO)

21561 DOSE CALCULATION FOR COBALT-60-ROTATIONAL IRRADIATION WITH CONSTANT PENDULUM RADIUS. Guenter Schoknecht (Städt. Auguste-Viktoria-Krankenhauses, Berlin-Schoneberg). Strahlentherapie, 120: 525-32(Apr. 1963). (In German)

Formulae for dose calculation of the Co^{60}-rotational radiation with constant pendulum radius are derived. Pendulum isodoses by using given fixed field isodoses should be obtained in this way. The calculation is based on the dose rate in the pendulum axis. The values are given as percentage of the calibration value. The method is described by using an example. (auth)

21562 SYSTEMATIC INVESTIGATION OF THE ACTUAL RADIATION DOSE TO THE PATIENT IN THE THERAPEUTIC USE OF FAST ELECTRONS, CONVENTIONAL AND ULTRA-HARD X RADIATION. 4. DISCUSSION OF RESULTS AND REPORTS. Detlev Schoen (Universität, Tübingen, Ger.). Strahlentherapie, 120: 533-49(Apr. 1963). (In German)

A historic survey is presented of experiments which were done to determine the total radiation burden of the organism during therapeutic radiation procedures. Neglect of the radiation energy scattered beyond the radiation cone changes the meaning of the expressions volume dose and integral dose, respectively. Results of the dose measurements within and beyond the radiation cone in a water phantom are reported as typical examples of the half deep and deep therapy with conventional and high energy radiations. Consideration of side scattering during determination of the total burden leads in certain situations to a new orientation in judgment of the usefulness of therapeutic radiation procedures. (auth)

21563 INVESTIGATION OF WHOLE-BODY COUNTING AFTER INCORPORATION OF RADIONUCLIDES. Hermann Muth and Erich Oberhausen (Universität des Saarlandes, Hamburg/Saar). Strahlentherapie, 120: 550-8(Apr. 1963). (In German)

Whole-body counters offer the possibility of precise measurements of deposits of gamma-emitting radionuclides in the human body in a relatively short time. If several radionuclides are present in the body, the differ-

ent nuclides can be identified by an analysis of the gamma spectrum. Results obtained with a whole-body counter, using a liquid scintillator and a crystal counter (8" NaI Tl) combination with the same lead shield, are reported. With this arrangement measurements in persons with radium deposits and in thorotrast-patients were carried out. (auth)

21564 POST-RADIOLOGICAL BONE MARROW REGENERATION. DEPENDENCE ON THE RADIATION QUALITY. Bruno Choné (Universität, Heidelberg). Strahlentherapie, 120: 566-75(Apr. 1963). (In German)

Continuing previous bone marrow investigations, control bone marrow punctures were done in 30 patients at different time intervals after the end of irradiation using supervoltage therapy (Co^{60}). The temporal course of bone marrow regeneration in the irradiation area was studied. The results are compared with those obtained after the therapy with conventional radiation. The bone marrow tolerance, relating to a potential regeneration ability, seems to be 30 to 40% higher for ultrahard radiation. (auth)

21565 THE BEHAVIOR OF SERUM ELECTROLYTES UNDER RADIOGOLD IRRADIATION. August Verhagen and Fritz Stelzer (Ev. Krankenhauses Plettenberg/Westf., Ger.). Strahlentherapie, 120: 582-6(Apr. 1963). (In German)

A decrease of the sodium level of the serum was observed after treatment with radioactive gold-198. Normal values were reached after the 5th to 6th day after single injection. A potassium increase in the serum appears at the same rate as the sodium level decreases. The calcium level is not influenced by irradiation. (auth)

21566 THE EFFECTS OF IONIZING RADIATION ON THE BLOOD VOLUME AND THE ELECTROLYTE BALANCE OF THE HEART AND SKELETAL MUSCLES OF RATS. Hans Hochrein, Heribert Braun, Manfred Reinert, and Barbara Kriegsmann (Universitätsklinik, Würzburg, Ger.). Strahlentherapie, 120: 587-97(Apr. 1963). (In German)

Following whole-body x irradiation with 600 r concentration of intracellular electrolytes, water-content, and extracellular volume phase of heart and skeletal muscle were examined in rats. Active plasma and blood volume were determined concomitantly. Changes reported were attributed to lesion of cellular membrane, dehydration, and metabolic interference. Shock was the final result of these various mechanisms. (auth)

21567 BIOGENIC AMINES IN URINE AND BLOOD OF RATS AFTER SUBLETHAL WHOLE-BODY IRRADIATION. Franz Franzen, Hubert Gross, and Guenter Thielicke (Universitätsklinik, Cologne). Strahlentherapie, 120: 598-610(Apr. 1963). (In German)

A considerable increase of tryptamine, serotonin, bufotenin, histamine, dopamin, l-noradrenalin, and adrenalin, which is dose-dependent, was observed in the urine and blood of rats 21 and 9 days, respectively, after a single total-body irradiation with 400, 600, and 800 r, using a fluorescence-spectrophotometer. The increase of the amines and the radiation syndrome developed gradually and simultaneously. (auth)

21568 FURTHER STUDIES OF THE EFFECTS OF CARDIAC IRRADIATION UPON MYOCARDIAL VASCULARITY. Elliot Senderoff, A. Robert Beck, and Ivan D. Baronofsky (Mt. Sinai Hospital, New York). Surgery, 49: 381-6(Mar. 1961).

Experiments in dogs were undertaken to test the ability of cardiac irradiation to induce coronary arterial collateral circulation. Dogs received 2000 r cardiac irradiation and were subjected to ligation of the left circumflex coronary artery at its origin 7 days after irradiation. Only 8% of the nonirradiated dogs survived 48 hr or longer after the ligation in contrast to 40% of the irradiated dogs. Irradiated dogs also exhibited better electrocardiograms, greater intercoronary flow, and more vascular hearts as determined by corrosion studies. Electrocardiograms taken 2 to 7 hr after ligation in nonirradiated dog hearts, which did not fibrillate, showed the presence of severe infarctions with marked S-T elevations, also ventricular tachycardia, flutter with varying degrees of block or complete heart block. The electrocardiograms of irradiated animals also showed evidence of infarction but the S-T segments were not so sharply elevated. The results show that cardiac irradiation induced a dilatation of the intercoronary anastomotic bed, thus accounting for increased survival rate and retrograde blood flow regardless of which portion of the heart vasculature is ligated. (TCO)

21569 IDENTIFICATION OF PERITONEAL MACROPHAGES IN MOUSE RADIATION CHIMERAS. H. Balner (TNO, Rijswijk, Netherlands). Transplantation, 1: 217-23 (Apr. 1963).

Using the cytotoxic activity of specific isoantisera it was found that free peritoneal macrophages of mouse radiation chimeras are completely replaced by donor-type macrophages about 6 weeks after irradiation and administration of homologous bone marrow. Possible implications regarding the genotype of the fixed reticuloendothelial cells of chimeras are discussed. (auth)

21570 CARDIOVASCULAR CHANGES IN RADIATION DISEASE. Vilo Jurkovic and L. Vokrouhlicky. Vojenske Zdravot. Listy, 31: 253-8(Dec. 1962).

Histologic, biochemical, and functional processes leading to cardiovascular lesions following irradiation are reviewed and discussed. (TCO)

21571 RADIATION-INDUCED MALIGNANT HEMANGIOBLASTOMA. Claus Legerlotz (Städtische Krankenanstalt, Essen). Zentr. Allgem. Pathol. Pathol. Anat., 104: 59-66(Dec. 27, 1962).

The development of a metastasizing hemangioblastoma 10 yr after radiotherapy of another malignant tumor is reported. The patient at the age of 40 had been treated for a squamous cell uterine carcinoma by Ra implantation (3500 mg-hr) and x rays (2400 r). The abdominal skin showed no unusual radiation reaction subsequent to therapy until 8 yr later, when bluish blisters and nodules, accompanied by painful ulceration, were noted. Biopsy 10 yr postirradiation showed an infiltrating, rapidly spreading hemangioblastoma in abdominal skin in the irradiated zone. Development of the tumor appears to have proceeded through the stages: skin atrophy, telangiectasia, hyperkeratosis, ulceration. Reasons are advanced for believing that the tumor was radioinduced. (H.H.D.)

21572 EFFECTS OF RADIATION ON GERM CELLS OF INSECTS: DOMINANT LETHALS, GAMETE INACTIVATION AND GONIAL CELL KILLING. R. C. von Borstel (Oak Ridge National Lab., Tenn.). IAEA Preprint No. SM-40/34. 25p.

To be published in IAEA Proceedings of the Symposium on the Use and Application of Radioisotopes and Radiation in the Control of plant and Animal Insect Pests, held in Athens, Greece, April 22-26, 1963.

A review is presented of radiation methods of insect population control. (56 references) (T.R.H.)

21573 IONIZING RADIATION: AN OLD HAZARD IN A NEW ERA. George Tievsky, ed. Springfield, Ill., Charles C. Thomas, 1962. 168p. $8.00.

The hazards to society from increasing amounts of environmental radiation are reviewed. The physical aspects of radiation, radiation biology, and genetic effects of radiation are discussed in language that is understandable to those with little background. Emphasis is placed on the radiation dose received during diagnostic radiographic examinations and radioactive fallout. Protective measures against radiation injuries are described. (C.H.)

21574 THE EFFECTS OF VARIOUS AGENTS ON THE GROWTH AND RADIATION SENSITIVITY OF STRAIN L. Anthony Antoine Rene. Thesis, Washington, D. C., Catholic Univ. of America, 1962. 46p.

Nine newly synthesized agents were tested for possible protective effects on irradiated mammalian cells. Strain L cells were cultured as monolayers in the presence of an appropriate concentration of one of the nine potential antiradiation agents. Doses of 500, 1000 and 1500 r were used (cobalt-60, 22 r/min). The effects of radiation on Strain L cells were assessed along two parameters: 1) effect on cell multiplication and 2) effects on total culture volume and individual cell volume. Doses of 500, 1000 and 1500 r had a marked inhibitory effect on cell multiplication within 48 hr after irradiation. The agents ranged from fairly good radio-protectors to radio-sensitizers. The ten agents (nine newly synthesized agents and AET) are listed below in order of their decreasing protective activity and increasing sensitization of cells to radiation: S,2-aminoethylisothiouronium · 2HBr (AET), S,3-aminopropylisothiouronium · Br · HBr, B-(N-methylammonium)-N-ethylthiosulfate, Quinoxaline-1,4-di-N-oxide, N,N-bis 2-hydroxyethyldithiooxamide, 2-aminothiazoline · HBr, Unithiol, S,(3-aminopropyl)-N-methylisothiouronium · Br · HBr, S,allylisothiouronium · HBr, Sodium diethyldithiocarbamate. The "radical scavenger hypothesis" and the mechanism involving the oxygen reduction are the currently preferred explanations of the action of some protective compounds. None of the agents included in this study appear to be capable of producing anoxia. It has been postulated that the mechanism of action of sulfhydryl compounds is through the protection of sensitive sulfhydryl groups by the formation of temporary mixed disulfides. The formation of mixed disulfides between the target molecule and the protector is envisaged to offer a partial protection against direct hits by providing additional possibilities for dissipation of the radiation energy. It is also believed that the mixed disulfide bond can serve as the ultimate source of the electrons repairing ionizations created by direct hits. (M.P.G.)

21575 SOME EFFECTS OF IRRADIATING SUCCESSIVE GENERATIONS OF HYMENOLEPIS DIMINUTA. Paramal Simon Job. Thesis, Knoxville, Tenn., Univ. of Tennessee, 1962. 96p.

A study was undertaken to determine some of the cumulative effects of radiation on Hymenolepis diminuta. The cysticercoids of the worms in Tribolium confusum were subjected to 15,000 r gamma radiation. These irradiated cysts were fed to rats of the same sex and of comparable age, weight, worm burden, genetic background, and care. The eggs from these worms were fed to beetles, and the cysticercoids were subjected again to a dose of 15,000 r. The whole process was repeated for eight successive generations, thereby building up the cumulative dose to 120,000 r. Length of worms, variation of lengths of worms within the same host, anomalies of proglottids, abnormalities of reproductive organs, and the infectivity of cysticercoids were observed in the unirradiated, and the progeny of 60,000 r and 120,000 r groups of worms, and analysis of variance was done wherever reasonable. Results show that repeated irradiation tends to inhibit growth, increase the frequency of various anomalies, perhaps decrease the number of testes per proglottid, and perhaps diminish adaptive value of individuals. Selection pressure opposes each of the above effects of radiation. The two forces acting together bring about a sort of stability. The present study is useful in evaluating the relative stability of any given morphological character for taxonomic purposes, and also emphasizes differences among characteristic anomalies in terms of their sensitivity to radiation. (M.P.G.)

21576 X-RAY INDUCED INCORPORATION OF TRITIATED THYMIDINE INTO GRASSHOPPER NEUROBLAST CHROMOSOMES. Richard Allen McGrath. Thesis, Knoxville, Tenn., Univ. of Tennessee, 1962. 62p.

Neuroblasts of the grasshopper Chortophage viridifasciata (De Geer) were used to study incorporation of tritiated thymidine (H_3Thd), a deoxyribonucleic acid (DNA) precursor, into chromosomes. Embryos were made into hanging drop cultures which contained H_3Thd and exposed to 32 or 250 r of x rays. Individual cells were identified and observed by bright field microscopy for periods of time which ranged from 15 min to 6 hrs after irradiation. At the end of the observation period embryos were either sectioned or made into squash preparations. In the former case preselected neuroblasts were reidentified; in the latter they were not. Results of observations of living neuroblasts in hanging drop cultures are presented. Autoradiograms were prepared for the assay of H_3Thd incorporation by grain counting methods. Information obtained from the autoradiograms is discussed. Results are interpreted as a reflection of repair of x-ray-damaged DNA. A correlation is suggested between detectable chromosome breakage, the normal DNA synthesis period, and labeling of delayed, stopped or reverted prophase neuroblasts. (M.P.G.)

Radiation Sickness

21577 (JPRS-19066) THE USE OF ACTH AND ADRENAL CORTICAL HORMONES ON INDIVIDUALS WHO HAVE BEEN EXPOSED TO THE EFFECT OF IONIZING RADIATIONS. N. A. Kurshakov, N. N. Rynkova, and I. I. Sokolova. Translated from Probl. Endokrinol. i Gormonoter., No. 2, 73-6(1963). 8p. (OTS-63-21754)

Hormone therapy (ACTH, cortisone, and prednisolone) in individuals who had been subjected to radiation effects improved their general condition, raised the amount of leucocytes, neutrophiles, and thrombocytes, with a simultaneous reduction of the number of eosinophiles, and lead less frequently to moderate lymphopenia and monocytopenia. The appearance in the peripheral blood of a left nuclear switch to myelocytes and promyelocytes in response to the administration of the above-mentioned hormonal preparations may indicate an accelerated maturation and washing out of neutrophils. Prednisolone therapy in Werlhof's syndrome may lead the patients out of the thrombopenic crisis, and the prolonged use of small doses of this preparation will maintain the achieved effect. (auth)

21578 (OTS-62-11069) ARCHIVUM IMMUNOLOGIAE ET THERAPIAE EXPERIMENTALIS. Translated Reprint of Archives of Immunology and Experimental Therapy. Vol. 10, No. 1, 1962. 318p.

Translations are presented of papers on various aspects

of immunology and experimental therapy. Topics covered include electrolyte balance; the color and optical properties of subcutaneous fat in cancer patients; the effects of tannin on phagocytic activity of leukocytes, bacteria, and viruses; the antigenic structure of Staphylococcus aureus; antigenic reactions to tubercle bacilli; agglutinating properties of yeasts; the pharmacologic properties of sulfur derivatives of theophylline; the antibacterial effects of nitrofurazone combined with antibiotics; the application of statistical analysis in predicting the sensitivity of microorganisms to antibiotics; and the advantages, limitations, and some results using electron microscopy. A separate abstract was prepared on one paper on radiation sickness. (C.H.)

21579 (OTS-62-11069(p.14-18)) DISORDERS IN THE DISTRIBUTION OF WATER BETWEEN THE EXTRACELLULAR SPACE AND CELLS IN ACUTE RADIATION DISEASE. Stanislaw Košmider and Edmund Rogala.

Disorders in distribution of water between the extracellular space and cells as a result of osmotic changes within the cells induced by ionizing rays depend on the dosage of radiation. In proportion to increasing dosage of radiation, the time of transfer of water from the extracellular space into cells is shortened. Changes in the volume of extracellular water may offer an explanation of the relation of morphologic alterations to the dosage of ionizing rays. (auth)

21580 INFLUENCE OF THE N-PHENYLAMIDINE OF THIOPHENE-2-CARBOXYLIC ACID ON THE BONE-MARROW CHANGES IN ACUTE RADIATION SICKNESS. D. G. Zografov and I. A. Baev. Acta Biol. Med. Ger., 8: 337-43(1962).

White male rats were irradiated with 650 r, 5 min after administration of 5 mg/100 g of a 1% solution of N-phenylamidine of thiophene-2-carboxylic acid (PTC) in acetic acid. Controls were rats that were either only irradiated, or rats that received only PTC. 1, 3, 5, 10, 15, and 30 days after irradiation the rats were anesthetized and about 1000 cells of bone marrow were removed from their tibias and examined in smear preparations. The mitotic index in PTC-protected animals was significantly higher than in irradiated controls. There were more immature granulocytes and erythroblasts in the protected rats one day after irradiation but there was no difference in lymphocytes or megakaryocytes. The results indicate that radiation damage is smaller and that there is a quicker recovery of all types of cells except lymphocytes in rats protected by PTC. (OTS)

21581 AUTOLOGOUS BONE MARROW INFUSIONS AND SHIELDING AS PROTECTIVE AGENT AGAINST LETHAL TOTAL-BODY IRRADIATION IN THE DOG. Donald L. Lamb and William D. Kelly (Veterans Administration Hospital, Minneapolis). Ann. Surg., 154: 985-9 (Dec. 1961).

Successful results are reported on the protection of dogs against 480-r doses of x rays with fresh autologous marrow, stored autologous marrow, and shielding the hind limbs. All control dogs died 6 to 18 days after receiving 480-r whole-body irradiation, with a mean survival time of 12.6 days. All of the dogs showed extensive hemorrhagic pneumonitis, but none had gastrointestinal ulceration or perforation at autopsy. Six of 8 dogs in which one hind leg was shielded with lead died 8 to 18 days following irradiation. Two were alive and well 50 and 75 days later, respectively. Four dogs in which both hind legs were shielded with lead were alive after 45 days, but rib biopsies revealed hypocellular marrow. Of 30 dogs given autologous bone marrow immediately after receiving 480-r whole-body irradiation, 11 survived 45 days or longer and the remaining dogs are alive and well 8 to 22 months later. Hemoglobin, leukocyte, differential, and platelet counts all returned to normal within 2 months, and leukocyte and platelet counts returned to normal values within 3 weeks. There were no survivors in 17 dogs receiving less than 2 billion marrow cells, but all 7 dogs receiving more than 3 billion cells survived. Of 7 dogs receiving between 2 and 3 billion cells, 5 survived. (TCO)

21582 OSTEOGENIC SARCOMA IN A LUMINOUS WATCH DIAL PAINTER. Carl Davis, Jr., R. Gordon Brown, and R. W. Alexander (Presbyterian-St. Luke's Hospital, Chicago and Univ. of Illinois, Chicago). Arch. Surg., 86: 190-5(Feb. 1963).

The case history is presented of a 52-year-old female who developed radiation osteitis of multiple bones and an osteogenic sarcoma of the right ilium that proved fatal. The patient had been treated erroneously over a period of years for rheumatoid arthritis involving the shoulder and hip joints. Considerable pain and limitation of motion were experienced in spite of medical therapy. Roentgenograms of the long bones, vertebral bodies, and pelvic bones with destruction of both acetabula demonstrated the characteristic pathological changes resulting from irradiation of bone. The patient was unaware that she had received a harmful dose of radioactivity as a result of her occupation as a watch dial painter 30 years earlier. The paint used on the watch dials consisted of crystalline phosphorescent zinc sulfate, rendered luminous by the addition of extremely small amounts of radium and mesothorium or radiothorium. Ingestion of the paint occurred as the result of the workers' habit of pointing their brushes in their mouths before painting the dials. (H.H.D.)

21583 STUDIES ON THE BIOLOGICAL PREVENTION OF ACUTE RADIATION INJURY. I. PREVENTION WITH HOMOGENATES OF ORGANS AND TISSUES OBTAINED FROM IRRADIATED ANIMALS. C. Arghittu, G. De Renzi, and V. Lamarche (CNEN, Leghorn, Italy). Boll. Soc. Ital. Biol. Sper., 36: 1226-30(Nov. 30, 1960).

Homogenates of heart, liver, spleen, kidney, adrenal, testis, and femoral muscle were prepared after irradiation of 40-day-old male mice with 800-r doses of Co^{60} γ rays. Homogenates were similarly prepared from nonirradiated mice organs, and like the 1st preparations, were injected intraperitoneally in 0.1-, 0.2-, and 0.3-ml doses at weekly intervals in mice irradiated with 800 r. Such whole-body irradiation was given 1 week or 24 hr after the last 3 weekly injections of homogenate. Significant radioprotection was provided by the injected homogenates and that obtained from irradiated animals was slightly more protective than that from controls. Irradiated, uninjected mice showed only a 30% 30-day survival rate. This was increased to 70% in mice injected with homogenates of irradiated organs 1 week after irradiation of the recipients and to 80% when it was injected 24 hr after irradiation, in contrast to 70% when control homogenate was injected at 24 hr. The homogenates were well tolerated in the recipient mice and did not interfere with growth. The body weight gain of irradiated surviving mice was greater after injection of the homogenates. (H.H.D.)

21584 ADULT LEUKEMIAS AND DIAGNOSTIC X RAYS. Alice Stewart, Winifrid Pennybacker, and Renate Barber (Oxford Univ.). Brit. Med. J., 2: 882-90(Oct. 6, 1962).

A survey was made to detect possible associations between exposure to medical x rays and the subsequent development of malignant diseases in adults. Data were ob-

tained from 963 cases of leukemia, 60 of lymphosarcoma, 951 of other cancers, and 974 control subjects. The leukemias included 512 lymphatic leukemias and 511 other leukemias (referred to as the M series). X-ray exposures which involved the trunk (chest and abdomen) were reported more often by M series leukemias than other subjects. The difference between M series leukemias and other subjects with respect to trunk x-ray exposures was greater for therapeutic than diagnostic exposures. For diagnostic exposure there was a peak incidence for M series leukemias 3 to 5 yr before the onset of symptoms. It was concluded that about 8% of leukemias other than lymphatic leukemias were caused by diagnostic x rays, and a further 3.6% by therapeutic x rays. It was estimated that 1 leukemia death occurred for every 46000 x-ray examinations of the chest or abdomen in Britain in 1951-5. (TCO)

21585 RESTORATIVE EFFECTS OF A SATURATED TRIGLYCERIDE OF ANIMAL ORIGIN ON RADIODERMATITIS AND DYSTROPHIC ULCERS. Ettore Guidetti (Ospedale San Cottolengo, Turin). Clin. Terap., 21: 140-3 (Aug. 1961).

The glyceride was obtained by a modified method. The final product, a white powder, had an iodine number of less than 4, a saponification number of 199, a mp of 55.5°C, and was neutral. It was completely soluble in acetone at 40° and in chloroform, slightly soluble in ethyl ether and boiling ethanol, and insoluble in water. It did not contain nitrogen or phosphorus, and upon saponification yielded glycerol and saturated fatty acids. The product appeared to consist of 75% trimyristin (and small amounts of laurodimyristin and myristindilaurin) and 25% myristin-stearin triglycerides. When it was locally applied to the skin of mice irradiated with 10000 to 15000 r in the gluteal region, it accelerated and improved the healing of the ulcerated lesions. A similar effectiveness against radiodermatitis in rats was noted when it was applied to skin instead of Vaseline. An ointment containing the glyceride and sulfonamides was used to treat the cutaneous lesions of 12 patients with radiodermatitis, 30 with ulcerated varicosities, and 11 with decubital ulcers. In all dermatitis cases, improved healing was noted. This was seen by increased rates of scar formation and a decrease in exudation, erythema, and pain. Good results were also obtained in the 2nd group and more modest results in the 3rd group. No allergic reactions or other side-effects were noted. (H.H.D.)

21586 CHANGES IN THE RETINAL INTERMEDIATE SUBSTANCE AND CERTAIN HISTOCHEMICAL SHIFTS IN RADIATION SICKNESS. V. M. Abdullaev. Dokl. Akad. Nauk Azerb. SSR, 18: No. 11, 81-5(1962). (In Russian)

The pathological effects of radiation sickness on the argyrophile laminar substance in the eyes of animals were studied using 35 rabbits and 20 dogs exposed to single doses of 792 and 692 r, respectively. The diagnosis was based on clinical, hematological, and pathological-anatomical analyses. It was observed that at various stages of injury vitamin C and glucogen contents vary in various sections of the retina. Especially noticeable was an irregular thickening in the back and sides of retina. The laminar structure was impaired (especially the exterior), and various lumps and grains were exhibited. Pictures of examined tissues showing increased and weakened argyrophile response in the rodecone layer are shown. (R.V.J.)

21587 TRAIL OF A NEW ANTIEMETIC AGENT, TIGAN IN RADIATION SICKNESS. J. Reboul, G. Delorme, J. Tavernier, and M. Geindre (Faculté de Médecine, Bordeaux). J. Med. Bordeaux Sud-Ouest, 138: 760-5(June 1961).

The use of various kinds of drugs in preventing early symptoms of radiation disease in patients receiving radiotherapy is reviewed, and the results obtained by the use of Tigan (trimethobenzamide) in preventing nausea and vomiting in 100 irradiated patients is described. Preliminary studies in rats showed that it has a hypotensive action only 1/1000 that of chlorpromazine, which also shows antiemetic activity, but less than that of Tigan. Tigan was administered to the irradiated subjects at the first sign of nausea in the form of tablets, taken orally 3 or 4 times a day, or by intramuscular injection. In 80% of the 100 irradiated patients (65% of whom were women) nausea and vomiting were prevented, in 18% the results were fairly satisfactory, and in 2% unsatisfactory. The study included 30 control patients administered a placebo. Side-effects of the drug were few (skin reactions in 2 cases and fever and generalized urticaria in another) and it appeared not to cause any hematologic changes. It was concluded that the drug is useful in preventing nausea resulting from radiotherapy, even though it is not effective in controlling some of the other symptoms of radiation sickness such as anorexia and lassitude. (H.H.D.)

21588 EVALUATION OF THE PROTECTIVE EFFECT OF CYSTEAMINE. N. Sarolta Sulyok, Endre Czeizel, Geza Gyuru, and Gyorgy Vaczo. Magy. Radiol., 15: 49-52 (Jan. 1963).

After intraperitoneal injection of cysteamine, survival time of mice was measured after irradiation with 650 r doses. Under similar conditions, liver degeneration of partially hepatectomized rats was studied after 500 r radiation. Also, granulocytosis produced after the injection of a starch solution in rabbits irradiated with 400 r was tested with and without cysteamine. Survival time increased and liver damage decreased if cysteamine was administered before irradiation, the functional insufficiency of the bone marrow of rabbits, however, showed no lessening with cysteamine. (auth)

21589 RADIOPROTECTION OF MICE BY HYPOXIA AND CHEMICAL AGENTS. William E. Rothe, Marie M. Grenan, and Shirley M. Wilson (Walter Reed Army Inst. of Research, Washington, D. C.). Nature, 198: 403(Apr. 27, 1963).

The 30-day survival of mice irradiated while breathing 5% oxygen was compared to those irradiated while protected by combinations of hypoxia and chemical agents. Hypoxia reduced the effectiveness of radiation by a factor of 2.5. Aminopropiophenone and 5-hydroxytryptamine, both thought to operate through oxygen-dependent pathways, did not add to the protection afforded by simple hypoxia. Dimethylsulfoxide and diethyldithiocarbamate also failed to significantly increase the effectiveness of low oxygen tension. However, the thiol compounds, cysteamine, cystamine, and 5,2-aminoethylisothiuronium consistently added to the protection afforded by hypoxia. Possible reaction mechanisms involved in chemical radioprotection are discussed. (C.H.)

21590 ACTION OF ANTIRADIATION DRUGS AND THE "OXYGEN EFFECT." S. P. Yarmonenko, G. A. Avrunina, V. S. Shashkov, and R. D. Govorun. Probl. Kismich. Biol., 2: 388-91(Dec. 1962).

The dependence of antiradiation protection on density of ionization was checked experimentally by exposing white mice to whole-body irradiation by 660-Mev protons. The average density of the pulsed proton beam was 10^8 to 10^9

proton/cm^2/sec. Pulse duration varied from 200 to 400 μsec. The rate of pulsation was 100 pulses/min, so that the actual density and corresponding absorption dose were 10 to 50 times as high. The minimum absolute lethal dose for mice was 1200 to 1300 rad. Antiradiation drugs administered were: cysteamine (β-mercaptoethylamine), serotonin (5-oxytriptaminecreatinin sulfate), "S" (β-aminoethylisothiuronium bromide), cystamine (disulfide-cystamine dichlorhydrate), and hydroxylamine (hydroxylamine chlorhydrate). All drugs were administered intraventrally in physiological saline 10 to 15 min before irradiation, except cystamine, which was administered 30 min before irradiation. Dosage was 150 mg/kg, except for serotonin (50 mg/kg) and hydroxylamine (60 mg/kg). All the drugs improved resistance to radiation, drug "S" being the most effective. The experiments demonstrated the effectiveness of drugs against radiation by high-energy protons. The results are regarded as an indirect confirmation of the oxygen effect and of the dependence of effectiveness of chemical protection on the relative density of ionization. (TCO)

21591 THE EFFECTS OF SEDATIVES AND NARCOTICS ON EXPERIMENTAL RADIATION INJURIES. Dietrich Winne (Max-Planck-Gesellschaft, Göttingen, Ger.). Strahlentherapie, 120: 611-24(Apr. 1963). (In German)

Data are presented on the effects of a number of narcotics on 30-day mortality of rats exposed to various radiation doses. Data on the pharmacological effects of the narcotics are included. A decrease in response to narcotics, as indicated by decreased sleeping time, was often observed before development of the radiation syndrome and an increase in sleeping time was noted after the development of the radiation syndrome. (C.H.)

21592 REACTION OF MOUSE INTESTINE TO SYMPATHETIC DRUGS DURING ACUTE RADIATION SICKNESS. Andrzej Danysz and Teresa Zaczek (Inst. of Pharmacology, Academy of Medical Sciences, Biolystok, Poland). Strahlentherapie, 120: 625-30(Apr. 1963). (In German)

The reaction of the intestine to parasympathicotonic, parasympathicolytic, sympathicotonic, and ganglioplegic substances was investigated in irradiated mice. A decrease of the motility reaction of the intestine to acetylcholine, prostigmine, iproniazid, nicotine, and hexamethonium was rated. No changes of the reactivity to pilocarpin, but increased sensitivity to atropine, adrenaline, and sympatole was observed. The results indicate decrease in sensitivity of the cholinergic and an increase in sensitivity of the adrenergic receptors of the intestine at the peak of acute radiation sickness in mice. (auth)

CHEMISTRY

General and Miscellaneous

Refer also to abstract 22794.

21593 (AEET/CD/11) SELECTED BIBLIOGRAPHY OF OXIDES OF CADMIUM. V. D. Damani, comp. (India. Atomic Energy Establishment, Trombay). 1962. 45p.

A bibliography on the physical and chemical properties of cadmium oxides and compounds formed by Cd with other oxides is presented. Most references are to papers abstracted in Chemical Abstracts to Dec. 1961 and Nuclear Science Abstracts to Dec. 1962. (J.R.D.)

21594 (ORNL-TM-355) CHEMICAL TECHNOLOGY DIVISION. UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, AUGUST 1962. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). May 7, 1963. Contract [W-7405-eng-26]. 95p.

HTU values on the 6-in.-ID foam column indicated that operation was more sensitive to liquid distributor design at lower flow rates and that a single centerline feed produced turbulence only in the upper 27 cm of countercurrent length. The Mark I stacked clone contactor was run with uranyl nitrate varying the configuration of the underflow chamber to produce a maximum efficiency of about 90%. The transuranium disconnect performance tests demonstrated the superiority of the surface seal concept over that of the line seal concept. Waste processing test R-67 using TBP-25 type waste is described. (auth)

21595 RECENT DEVELOPMENTS IN THE ORGANOMETALLIC CHEMISTRY OF TECHNETIUM. PREPARATION AND PROPERTIES OF A POLYNUCLEAR TETRACARBONYL. H. D. Kaesz and D. K. Huggins (Univ. of California, Los Angeles). Can. J. Chem., 41: 1250-4(May 1963).

A polynuclear tetracarbonyl of technetium, constituting a novel class of carbonyls for the manganese subgroup metals, is formed during the treatment of the pentacarbonyl, $Tc_2(CO)_{10}$, with sodium amalgam and subsequent acidification. The new derivative is characterized, and its possible structure is discussed. (auth)

21596 ENERGY TRANSMISSION FROM THE URANYL CATION TO PHTHALOCYANINE IN THE DISSOLVED AND THE ADSORBED STATES. G. I. Kobyshev, G. N. Lyalin, and A. N. Terenin (Zhdanov State Univ., Leningrad). Dokl. Akad. Nauk SSSR, 148: 1294-7(Feb. 21, 1963). (In Russian)

The relatively long life of about 10^{-4} sec of the UO_2^{2+} cation in the excited state was expected to favor the intramolecular transmission of the excitation energy. This problem was investigated by means of a photoelectric spectrophotometer using metal-free and Mg-containing phthalocyanine (H_2Phc and MgPhc) in dioxane and ethanol solution, respectively, as acceptor; the 366 mμ line from a Hg lamp served as the source of excitation. Addition of uranyl nitrate or acetate to the solutions changed their luminescence spectra. At 290°K only the MgPhc exhibited luminescence with a maximum at 673 mμ, while at 77°K a strong band was observed at 701 mμ, close to the maximum of H_2Phc. Addition of the uranyl ion caused a 20-fold increase in the intensity of the fluorescence. The dependence of the spectrum on the wavelength was determined in the 405 to 436 mμ range. The observed fluorescence of both solutions indicates a transfer of the excitation energy from the uranyl ion to the pigment molecule. (TTT)

21597 DEPENDENCE OF THE EQUILIBRIUM CONSTANT ON THE MOLECULAR BOND ENERGY AND THE ATOMIC MASSES IN ISOTOPIC EXCHANGE REACTIONS. A. M. Rozen and A. I. Mikhaĭlichenko (Mendeelev Inst. of Chemical Tech., Moscow). Dokl. Akad. Nauk SSSR, 148: 1354-7(Feb. 21, 1963). (In Russian)

The equilibrium constant and the partition coefficient of isotopic exchange reactions can be calculated with sufficient accuracy from the oscillation frequency of the molecules involved in the reaction. For this purpose, the correlation between the so-called "β-factors", in particular, the bond energy, which characterizes the specific isotopic exchange reaction and the potential energy constants, k_e, of the molecules must be established. The calculations indicate that the partition coefficient becomes larger if the isotopic exchange reaction is carried out between two compounds of the element which exhibit a very large difference between the bond energies. Use of strong complexing agents leads to a reverse effect. This has been repeatedly demonstrated experimentally in cases such as the protium–deuterium exchange between H_2O, H_2S, and H_2Se molecules in which the value of the β factor is 11.62, 5.4, and 4.42, respectively. Plotting the values of log ($\beta^n - 1$) and the logarithm of the mass for biatomic halides of the 1st, 4th, and 6th group of the periodic table, interalkaline molecules of the first group, and oxides of the 5th group, straight lines with identical slopes were obtained. The problem of separating two nonisotopic atoms is also reviewed briefly. (TTT)

21598 PHYSICO-CHEMICAL STUDIES OF COMPLEX FORMATION BETWEEN URANYL ION AND 5-HYDROXY-7,8- DIMETHOXYFLAVONE. Mohan Katyal and R. P. Singh (Univ. of Delhi). J. Indian Chem. Soc., 40: 117-20 (Feb. 1963). (In English)

5-Hydroxy-7,8-dimethoxyflavone forms an orange-colored, water-soluble complex with uranyl ions. The complex was studied in aqueous ethanol by spectrophotometric, potentiometric, and conductometric methods. These studies reveal that the complex molecule contains uranium and 5-hydroxyl-7,8-dimethoxyflavone in the ratio of 1:2. The complex obeys Beer's law. A method for spectrophotometric determination of traces of uranium was developed. (auth)

21599 SPECTROPHOTOMETRIC STUDY OF THE COLOUR REACTION BETWEEN THORIUM IONS AND GALANGIN. Mohan Katyal and R. P. Singh (Univ. of Delhi). J. Indian Chem. Soc., 40: 121-3(Feb. 1963). (In English)

Galangin (3,5,7-trihydroxyflavone) forms an intense yellow-colored complex with thorium ions. The color reaction was investigated for spectrophotometric determination of thorium. The complex shows maximum absorption at 410 mμ at pH 2.2. The region of maximum absorption shifts slightly toward the higher wave lengths with increase in pH and at pH 4.2, it occurs at 420 mμ. The system obeys Beer's law over the pH range 2.2 to 4.2 and the method can be satisfactorily used for spectrophotometric determination of small quantities of thorium. Molar composition of the complex, as determined by Job's and slope-ratio methods was found to be 1:1. (auth)

21600 ON THE VACUUM REDUCTION OF NIOBIUM PENTOXIDE WITH NIOBIUM CARBIDE. Hirozô Kimura

and Yasuo Sasaki (National Research Inst. for Metals, Tokyo). Nippon Kinzoku Gakkaishi, 26: 695-9(1962). (In Japanese)

Using the vacuum process, carbide reduction of niobium pentoxide due to the following reaction was investigated experimentally: $Nb_2O_5 + 5\ NbC = 7\ Nb + 5\ CO$. The mixing ratio of Nb_2O_5/NbC was varied from 33/67 to 45/55. By means of fluctuation measurements of pressure and temperature, it was clarified that the reaction began to proceed rapidly above 1700°C. Crude niobium metal, containing 96 to 97% Nb, was obtained easily by this process. The purification of crude niobium metal obtained above was examined in a series of vacuum refining experiments. Impurities, such as carbon, oxygen, and nitrogen in niobium metal decreased at the refining temperature above 2150°C at the pressure of 10^{-5} mm Hg. The removal of carbon during refining process was dependent on both temperature and oxygen content. Rapid removal of oxygen was observed in the presence of carbon. Cold rolling was attempted on each specimen of refined metals, and fabricable specimens containing above 99.7% Nb showed a Vickers hardness lower than 200. (auth)

21601 ON THE PRODUCTION PROCESS OF CRUDE NIOBIUM BY ARC REDUCTION. Hirozô Kimura and Yasuo Sasaki (National Research Inst. for Metals, Tokyo). Nippon Kinzoku Gakkaishi, 26: 699-703(1962). (In Japanese)

Crude niobium metal containing about 99% Nb was obtained from a mixture of niobium pentoxide and niobium carbide by arc reduction by the following reaction: $Nb_2O_5 + 5\ NbC \rightarrow 7\ Nb + 5\ CO$. Mixtures of niobium pentoxide powder and niobium carbide powder were pressed into briquettes. To proceed with the above reaction at high temperature, they were arc-melted by using a laboratory argon-arc furnace with tungsten electrodes and a water-cooled copper crucible. The effects of melting time, argon pressure, and number of times of remelting on the reaction were investigated. The purity of reductants as crude niobium metal, the composition of furnace gas, and the weight losses during arc melting were examined. It was observed that a large amount of CO gas was generated from the molten specimen during arc-melting. Increase of niobium content in reductants was remarkable on account of both the reaction and the vaporization of niobium monoxide especially in low pressure melting. (auth)

21602 DISSOCIATION PRESSURE OF STRONTIUM FLUOBERYLLATES. A. V. Novoselova, F. Sh. Muratov, and L. P. Reshetnikova. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 36-7(Sept.-Oct. 1962). (In Russian)

The dissociation pressure of $SrBeF_4$ was studied at 915 to 1145°C. The data show that only one BeF_2 is found in the condensate at 1010°C. The dissociation equation is $SrBeF_4$ (melt) $\rightleftharpoons$ SF_2 (in $SrBeF_4$ melt) + BeF_2 (gas) at 1010 to 1145°C. The equilibrium constant as a function of temperature is $\lg Kp_{atm} = 1.8162 - 6392/T$ at 1283 to 1418°K. The heat of dissociation for strontium fluoberyllate is ΔH_T^0 (1283 to 1418°K) = 29.0 ± 3.0 kcal/mole. (R.V.J.)

21603 STUDIES OF U(IV)–U(III) SYSTEM. I. P. Alimarin, E. P. Nikolaeva, and V. M. Maslovich. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 50-4(Sept.-Oct. 1962). (In Russian)

Electrolytic reduction of uranyl salts on a mercury cathode in sulfuric, hydrochloric, and perchloric acid media was studied. It was found that the maximum reduction can be achieved with 0.4 N perchloric solutions during a 2-hr electrolysis at 12 to 15°. Measurements were made of U(IV)–U(III) system oxidation–reduction potential on tungsten electrode. Ammonium vanadate titration of U(III) was achieved using tungsten electrode. (R.V.J.)

21604 STUDY OF COMPLEX FORMATION OF Be BY ION EXCHANGE. I. BEHAVIOR OF Be IN SOLUTIONS OF PERCHLORIC AND SULFURIC ACIDS. T. A. Belyavskaya and I. F. Kolosova. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 55-9(Sept.-Oct. 1962). (In Russian)

Ion exchange and paper electrophoresis methods were employed in studies of beryllium behavior in perchloric acid at $\mu = 0.1$. It was shown that Be^+ ion hydrolysis begins at pH ≥ 2 and polymerization at $[Be^{2+}] \geq 10^{-4}$. Studies were also made of Be behavior in sulfuric acid. It was found that $BeSO_4$ with stability constant $\beta = 5.28 \pm 0.42$ forms at $\mu = 0.5$ and $[H^+] = 0.1$. (R.V.J.)

21605 MIXED SODIUM AND CALCIUM URANATES. V. I. Spitsyn, Shih-hua Wang, and L. M. Kovba. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 60-2(Sept.-Oct. 1962). (In Russian)

X-ray phase analysis of the $Na_2U_2O_7$–$CaUO_4$ system revealed a reaction between the sodium and calcium carbonates and U_3O_8; sodium carbonate reacts first and is followed by calcium carbonate reaction at a higher temperature. The solubility of calcium monouranate in sodium biuranate is negligible and the x ray spectra of $Na_{0.875}Ca_{0.125}UO_{3.56}$ exhibit lines of monoclinic phase $Na_{0.75}Ca_{0.25}UO_{3.63}$ with a very dense cation-anion packing: a Sin β = b = c Sin β = 4.113 ± 0.002 μX; $\beta = 88° 16' \pm 4'$. Hexagonal phases with similar structure but contrasting axial ratios were found for $Na_{0.625}Ca_{0.375}UO_{3.69}$ to $Na_{0.375}Ca_{0.625}UO_{3.81}$ and $Ca_{0.75}Na_{0.25}UO_{3.88}$ to $CaUO_4$ compositions. (R.V.J.)

21606 REDUCTION OF URANYL VANADATES BY HYDROGEN. Shih-hua Wang and L. M. Kovba. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 63-5(Sept.-Oct. 1962). (In Russian)

X-ray phase analysis of uranyl vanadate reduction by hydrogen at 400 to 900° revealed UO_2 and V_2O_3 as final products. The $UO_3 \cdot V_2O_5$ and $2UO_3 \cdot 3V_2O_5$ reduction passed through intermediate phases. (R.V.J.)

21607 INVESTIGATION OF ROTATIONAL AND VIBRATIONAL FREEDOM IN MOLECULES BY CROSS-SECTION MEASUREMENTS WITH SLOW NEUTRONS. John Joseph Rush. Thesis, New York, Columbia Univ., 1962. 140p.

Using a crystal spectrometer at the Brookhaven Reactor, total neutron cross sections have been obtained for a series of hydrogen compounds at neutron energies from 0.0006 ev to 2 ev. The compounds investigated include eight ammonium salts, ammonia gas, KH_2PO_4, K_2HPO_4, and a series of liquid methylbenzenes. Cross sections were calculated from transmission measurements and were corrected for neutron absorption. Theoretical cross sections were also calculated as a function of neutron energy for ammonia gas and benzene, using the theory of Krieger and Nelkin. In the experimental section the spectrometer, sample cells, and a low-temperature cryostat are described. In addition the extension of the range of neutron wavelength of the mechanical monochromator is discussed in some detail. The results of these experiments show a definite correlation between the scattering cross sections for subthermal neutrons and the rotational and vibrational freedom of the molecules studied. At neutron energies far below thermal, the scattering cross section is proportional to the neutron wavelength, and the slope of cross section vs wavelength increases with the freedom of motion of the hydrogen atoms. Cross-section data are described and interpreted. The results of these experiments show that cross-section meas-

urements with subthermal neutrons provide a valuable technique for investigating the binding and freedom of motion of H atoms in molecules. The method may also be used to estimate barriers to rotation in simple molecules, thus offering a useful supplement to existing methods. (M.P.G.)

21608 IMPROVEMENTS RELATING TO METAL OXIDE SOLS. (to W. R. Grace & Co.). British Patent 924,235. Apr. 24, 1963. Priority date May 12, 1960, United States.

A process is given for preparing a silica-coated metal oxide sol, such as thoria or urania sol, for use as fuel in homogeneous reactors. The process comprises adding to the uncoated sol a sufficient amount of organic silicate to provide the required coating, heating the mixture to hydrolyze the silicate while maintaining the pH above the isoelectric point of silica, and stabilizing the coated sol by adjusting the pH to 7 to 9.5 with a hydroxide. The parent sol may have been previously prepared by electrodialysis or hydrolysis. (D.L.C.)

21609 PROCESS FOR THE PREPARATION OF MAGNESIUM–THORIUM ALLOY. (to Dow Chemical Co.). British Patent 924,415. Apr. 24, 1963. Priority date Feb. 25, 1959, United States.

A process is given for preparing Mg–Th alloys by reduction of ThF_4 with an excess of Mg. The process comprises mixing ThF_4 with LiF and an alkaline earth metal fluoride to form a low-melting salt mixture, and reacting the mixture with excess molten Mg. The salt phase is easily separated from the alloy. Several examples of the process are given. (D.L.C.)

Analytical Procedures

Refer also to abstract 22114.

21610 (DP-814) FISSION GAS SAMPLER. Paul H. Chismar (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1963. Contract AT(07-2)-1. 8p.

An apparatus was developed for measuring and sampling free gases in uranium oxide fuel elements. The apparatus was designed to release the gases contained in the element and collect a fraction of the gases for analysis. (auth)

21611 (EUR-203.f) LE DOSAGE DU SILICIUM ET DU COBALT DANS LES ACIERS INOXYDABLES PAR SPECTROGRAPHIE DES RAYONS X. (Determination of Silicon and Cobalt in Stainless Steels by X-Ray Spectrography). W. de Spiegeleer, C. Toussaint, and G. Vos (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 12p.

An x-ray spectrographic method for determining Co and Si in stainless steel is described. Standard alloy steel samples from NBS are used. The second-order Kα line is used for Co, and a correction for the matrix influence is introduced. The limits of sensitivity are 0.005% for Co and 0.02% for Si. (J.R.D.)

21612 (EUR-204.i) DETERMINAZIONE DELL'OSSIGENO NEL MONOCARBURO DI URANIO MEDIANTE ESTRAZIONE A CALDO NEL VUOTO. (Determination of Oxygen in Uranium Monocarbide by Vacuum Hot Extraction). A. Colombo (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). Mar. 1963. 11p.

The reproducibility of the hot extraction technique for determining oxygen in uranium monocarbide using commercial vacuum-fusion equipment was investigated. Gases are extracted by dropping the samples in a graphite crucible heated at 1960°C under vacuum, and are analyzed by means of a gas chromatograph. With samples weighing 50 to 100 mg, oxygen was determined with a relative standard deviation of about ±5% in the range 500 to 1000 ppm weight oxygen. The sensitivity of the analysis could be increased by increasing the sample size. Some indications on the behavior of the uranium monocarbide under different storage conditions are given. (auth)

21613 (PG-Report-219) ANALYTICAL METHOD FOR THE GRAVIMETRIC DETERMINATION OF URANIUM IN PURE AMMONIUM DIURANATE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 4p.

A portion of the sample is dissolved in nitric acid and an aliquot of the solution is taken. The uranium is precipitated as ammonium diuranate which is ignited and weighed. The method as written is suitable for all pure samples of ammonium diuranate. At the 48% level, the standard deviation is 0.16%. (auth)

21614 (PG-Report-232) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF FLUORIDE IN CRUDE URANYL NITRATE LIQUOR. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 9p.

Fluoride is separated by distillation from sulfuric acid solution. An aliquot of the distillate is titrated with thorium nitrate solution using alizarin red S or chrome azurol S as indicator. It is applicable from 5 μg/ml fluoride to 1.5% as written. The method is considered to be free from bias. At the 0.37% level the standard deviation is 0.005%. (auth)

21615 (PG-Report-375) ANALYTICAL METHOD FOR THE DETERMINATION OF THE TOTAL ALPHA ACTIVITY IN LOW ACTIVITY EFFLUENT SAMPLES BY A DIRECT COUNTING TECHNIQUE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 13p.

A suitable aliquot of the sample, dependent upon expected activity, is pipetted onto a prepared glass plate. The plate is placed under radiant heat lamps, and the liquor is evaporated to dryness. The plates are heated gently in a burner flame to remove the last traces of volatile matter and are then cooled and counted in an alpha scintillation counter. (P.C.H.)

21616 (PG-Report-376) ANALYTICAL METHOD FOR THE DETERMINATION OF TOTAL ALPHA ACTIVITY IN BORE-HOLE WATER BY A DIRECT COUNTING TECHNIQUE. (United Kingdom Atomic Energy Authority. Production Group., Springfields, Lancs, England). 1963. 9p.

A 500-ml portion of the sample is evaporated to a low volume. An aliquot is pipetted onto a prepared platinum counting tray and evaporated to dryness under infrared lamps. The counting tray is heated in a burner flame to remove all volatile matter and is counted in a low background alpha scintillation counter. (P.C.H.)

21617 (PG-Report-432) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF BORON IN URANIUM METAL POWDER. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 8p.

The U powder is dissolved in HCl and H_2O_2. The resulting solution is evaporated to dryness in the presence of H_2SO_3. Rosocyanin is formed, separated from the excess curcumin, and dissolved in ethanol for absorptiometric measurement. (auth)

21618 (RT/CHI(63)-6) THE SPECTROCHEMICAL DETERMINATION OF TUNGSTEN IN URANIUM, USING CONCENTRATION PRECIPITATION PROCEDURE. B. Podobnik and L. Lorenzini (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Feb. 1963. 12p.

A procedure is described for the determination of W in U and its compounds, by precipitating W with α-benzoinoxime, and exciting the conditioned precipitate by the d-c arc spectrographic technique. Molybdenum is used as the gravimetric carrier, and as the internal standard element. Taking 10 g of the sample to be analyzed, a sensitivity of 8 ppm W can be reached with the coefficient of variation of 5%. (auth)

21619 (TRG-Inf-Ser-202) DETERMINATION OF THE DISTRIBUTION OF PARTICLE SIZES IN POWDERS BY MEANS OF A PHOTOSEDIMENTOGRAPH. J. M. H. Fortuin and J. M. G. Prop. Translated by O. M. Cruse (U.K.A.E.A. Reactor Group, Risley, Lancs, Eng.) from Chem. Wiikblad, 57: 489-94(1961). 16p.

A method is described for determining the particle size distribution (1 to 40μ) of small powdered samples (5 to 30 mg). The measurement is carried out with a photosedimentograph consisting of a Leitz-sedimentometer, a light source of constant intensity, a commerical recorder, a thermostat, and other accessories. The analysis is semiautomatic and leads to accurate results within only one hour. (auth)

21620 COMBINED DEUTERON ACTIVATION AND AUTORADIOGRAPHY OF HISTOLOGICAL SECTIONS. Erik Odeblad and Karl Gustav Malmfors (Nobel Inst. of Physics, Stockholm; Sabbatsberg Hospital, Stockholm; and Karolinska Institutet, Stockholm). Acta Isotopica, 1: 127-36(1961). (In English)

Histological sections were mounted on thin Al foils, carbonized, and irradiated with deuterons in a cyclotron. After a few days the dominating activity was P^{32} arising from the reaction $P^{31}(d,p)P^{32}$. Autoradiographs showing the distribution of P^{32} therefore revealed the distribution of naturally occurring P^{31}. Analysis was also undertaken on the ovary, spleen, kidney, and brain. The spleen showed the most intense activation localized mainly in the Malpighian bodies. In the ovary, the follicular granulosa was especially activated. The quantitative interpretation and occurrence of artefacts is discussed. (auth)

21621 ACTIVATION ANALYSIS APPLIED TO DETERMINATION OF GOLD IN URINE FROM PATIENTS WITH RHEUMATOID ARTHRITIS TREATED WITH GOLD SODIUM THIOSULFATE. P. Helby and J. Rygard (Copenhagen County Hospital, Glostrup and Radium Centre, Copenhagen). Acta Rheumatol. Scand., 8: 222-8(1962). (In English)

A method employing activation analysis is described for measuring the Au content of urine. It permits detection of as little as 10^{-8} g Au per sample and 0.2 mg/l can be measured with an accuracy of 2%. The method depends upon the reaction of neutrons with Au^{197}, forming Au^{198} and γ radiation, which can be assayed radiometrically. Urine samples to be assayed were irradiated in a thermal neutron flux of 10^{12} N/sec/cm^2 for 3 days. In addition to Au^{198}, the activated samples contain significant amounts of other isotopes. The competitive isotopes were determined by gamma-spectrometric analysis and recording of a decay curve of Au-free urine. Maxima of Na^{24} were identified at 1.40 and 2.76 Mev, and it was shown $T^{1/2}$ = 15 hr for the activity during the first 7 days after removing the samples from the reactor. On the 10th day it was reduced to less than 1% of the original activity. After 18 days, background activity was reduced to 1½% around the Au^{198} peak at 411 kev. The activity was measured in a 10-v channel around the Au peak at 411 kev on the 18th and on the 27th day after removal from the reactor. The method described was applied to studies of the Au excretion rate in patients treated with Sanocrysin. Determination of Au excretion in a patient previously treated with Sanocrysin showed an excretion rate of 0.5 mg Au per day, measured on the 248th day after conclusion of the injections (the patient had received a total dose of 810 mg Au). (H.H.D.)

21622 THE DETERMINATION OF HYDROGEN IN MAGNESIUM ALLOYS. R. Berry and J. A. J. Walker (United Kingdom Atomic Energy Authority, Culcheth, Warrington, Lancs, Eng.). Analyst, 88: 280-6(Apr. 1963).

A method is described for determining hydrogen in magnesium alloys involving the simultaneous sublimation of magnesium from a graphite crucible and the removal of hydrogen from the furnace system. The amount of hydrogen extracted from a known weight of sample is determined by collecting the gas in a calibrated volume and measuring the pressure with a McLeod gage before and after diffusion through a palladium tube. The results for the reproducibility tests show the coefficient of variation to be not greater than 8 per cent for samples weighing between 0.05 and 2 g and having hydrogen contents between 6 and 140 ml per 100 g. Possible sources of error and the precautions necessary to minimize the errors are discussed. (auth)

21623 APPLICATION OF PENETRATING RADIATIONS IN HISTOCHEMISTRY: LOCALIZATION OF THOROTRAST (AND DERIVATIVES) IN CANCEROUS LIVER AND SPLEEN. J. Salmon and P. F. Ceccaldi (Laboratoire de Biologie Végétale de la Sorbonne, Paris). Ann. Histochim., 7, Suppl.: 29-33(1962).

Two histologic methods employing ionizing radiation were used to demonstrate the presence of thorium and its products in the tissues of a patient who died of cancer after having been injected with the radiopaque agent Thorotrast (colloidal ThO_2). Th was demonstrated by its absorption of x rays in a microradiographic technique and reflection electron microradiography. In the 1st method, 10 to 20-μ thick paraffin-embedded tissue sections were placed over a fine-grain photographic film and irradiated for 4 to 6 min with 20-kv x rays. On account of the absorption of x rays by Th and its products, the developed film showed granules and thin filaments representing deposits of the heavy element. The liver contained 5.4 times as much Th as the spleen. The 2nd method made use of secondary emissions from the Th in the form of photoelectrons produced by irradiation of tissue section with 180-kv x rays. In this technique the sensitive film was placed between the x-ray source and the tissue section to record the reflected emissions. The 2nd method confirmed the results obtained with the 1st. Both methods are recommended for the localization of heavy metal atoms in tissues. (H.H.D.)

21624 EXTRACTIVE DETERMINATION OF STRONTIUM-90 AND CERIUM-144 IN SAMPLES. F. Ya. Rovinskii and V. V. Ispravnikova. At. Energ. (USSR), 14: 285-9(Mar. 1963). (In Russian)

The standard radiochemical methods used for the quantitative determination of Sr^{90} and Ce^{144} in soil, silt, and ash samples require 12 precipitation steps to separate these isotopes from the other radioactive materials. A method was developed to separate these elements from a mixture of long-lived isotopes that requires a much shorter time than any of the previously employed ones; it is based on the joint extraction of the Y^{90} in equilibrium and of Ce^{144}(IV) from the solution obtained by dissolving the samples with

4M HNO_3, after removing the organic components by calcination at 400°C and adding up to 6M NH_4NO_3 to the solution. The extraction is carried out with tributylphosphate at a phase ratio of 1 : 1 within less than 5 min. Sr^{90}, Cs^{137}, and Ru^{106} are not coextracted with the Y and thus do not interfere with the analysis. The Pm^{147} isotope is taken up in the TBP phase but its low-energy β-particles were not recorded on the counter used in the determination. The precision of the method is comparable to that of the usual radiochemical analysis although it requires only $2\frac{1}{2}$ hours. The Ce^{144} can be determined subsequently in the same sample. (TTT)

21625 AN ACTIVATION METHOD FOR THE QUANTITATIVE DETERMINATION OF THE ORGANICALLY BOUND SULFUR IN POLYPHENYLS. Yu. G. Sevast'yanov, L. A. Bulanov, E. P. Kaplan, O. M. Nefedov, and A. P. Smirnov-Averin. At. Energ. (USSR), 14: 324-6(Mar. 1963). (In Russian)

The coal-tar benzene which is used as raw material for the preparation of organic reactor coolant-moderator materials, such as polyphenyls, contains up to 2 to 3% of organically bound S. During the pyrolysis of the benzene, some of this S passes into the polyphenyl which may have a S content of 0.5 to 1%. The fast neutron reaction $S^{32}(n,p)P^{32}$ with $T_{\frac{1}{2}}$ = 14.3 days and a β energy of 1.7 Mev makes the presence of S in a reactor material undesirable; in addition, the sulfides formed may present a corrosion problem. An activation method was developed for determining the S content of organic liquids. The analysis, based on the above reaction, consists in the comparison of the P^{32} activity of the sample with that of known reference materials. The specimens sealed in quartz containers were exposed to an integrated flux up to 10^{18} n/cm^2; after irradiation, they were held until the Na^{24} ($T_{\frac{1}{2}}$ = 14.5 days) was sufficiently decayed. The absorption and decay curves indicated that all the activity was due to P^{32}. The divergence of the analytical results did not exceed ±5%. By increasing the integrated flux, S concentrations in the 0.001 to 0.0005% range may be determined. The sensitivity may be further increased by a factor of 50 by concentrating the irradiated specimens. (TTT)

21626 RADIOACTIVATION ANALYSIS OF BROMINE AND IODINE IN ORGANIC COMPOUNDS USING A LOW-LEVEL NEUTRON SOURCE. Haruo Tsuji, Yuzuru Kusaka, and Yasuo Namikawa (Konan Univ., Kobe, Japan). Bull. Chem. Soc. Japan, 35: 2045-7(Dec. 1962). (In English)

Some experimental results are given for the activation analysis of Br and I in organic compounds using a Ra-Be neutron source. The sample was dissolved in a solvent, adjusted to constant volume, and irradiated. The results are tabulated for a large number of compounds. Although the sensitivity is low, the results are satisfactory. (D.L.C.)

21627 ON THE STUDY OF BORON DISTRIBUTION IN ALLOYS BY THE METHOD OF NEUTRON ACTIVATION. V. V. Levitin. Byul. Nauchn. Tekhn. Inform., Ukr. Nauchn. Issled. Inst. Metal., No. 8, 78-80(1960).

An investigation was carried out on the B distribution in Fe–B and stainless steel. A liquid emulsion was deposited, by dipping, upon microsections. The specimens were irradiated by thermal neutrons; a Po–Be source with power of ~3×10^6 neutrons/sec was used. A nonuniform distribution of B was noted in the Fe–B; in stainless steel no zones of intercrystallite B absorption were discovered, apparently because of their small thickness and insufficient resolving power of the radiographic method. (Referativnyy zhurnal, Metallurgiya, No. 11, 1961)

21628 UTILIZATION OF PAPER ELECTROPHORESIS FOR SEPARATION OF POTASSIUM, RUBIDIUM, AND CESIUM IONS. Tadeusz Pompowski, Jerzy Kowalczyk, and Irena Siemianowska. Chem. Anal. (Warsaw), 6: 393-8 (1961).

In order to separate K^+, Rb^+, and Cs^+, electrophoresis on No. 4 Whatman paper, in solutions of hydrochloric, lactic, and formic acids, or in mixtures of HCl and C_6H_5OH, was used. Optimum conditions for separation are: 0.1 N HCl, with 1.2% C_6H_5OH, and a potential gradient of 12.5 v/cm. To detect spots, $NaPb[Co(NO_2)_6]$ was used. (Referativnyy zhurnal, Khimiya, No. 6, 1962).

21629 THE β–γ PHOTOMETER AS A SIMPLE AID FOR ELEMENTAL ANALYSIS OF SOLUTIONS AND ORGANIC MATERIALS. K. H. Waechter. Chimia (Switz), 17: 113-19(Apr. 17, 1963). (In German)

The β–γ photometer was designed to effect the determination of the carbon-hydrogen relation of organic substances as well as analyses of elements with higher atomic numbers, like sulfur, chlorine, phosphorus, but also lead for instance, in organic compounds and aqueous solutions. The described method does not require any chemical preparation. The limits of determination depend on the element which has to be determined and on the radiation source which was used. When determining the carbon-hydrogen relation, a difference in the hydrogen portion up to 2‰ was detectable. A difference in the weight portion of sulfur and chlorine could be detected up to 0.1‰, and 0.5‰ for iodine. The method is suitable to control chemical processes where series of samples of similar composition are to be tested. (auth)

21630 ON THE STUDY OF INDIRECT APPLICATION OF RADIOACTIVE NUCLEI IN ANALYTICAL CHEMISTRY. PART IV. B. C. Purkayastha and A. K. Das (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 40: 169-71(Feb. 1963). (In English)

The present study deals with further extension of the work reported earlier to the determination of bismuth, palladium, and lead. The principle employed is to add excess of oxine and iodide mixture labeled with I^{131} to a slightly acidic solution containing the requisite cation and to measure the activity of a portion of the solution with a liquid counter. The loss in activity is a measure of the amount of cation present on the assumption that bismuth is precipitated as $(C_9H_7ON)H(BiI_4)$ and divalent ions like lead and palladium have compositions like $(C_9H_7ON)HMI_3$, where M stands for a divalent cation. Bismuth from 10 to 0.05 mg was estimated. Lead and palladium from 10 to 1.0 mg was thus far determined. The data lie always within statistical fluctuations. (auth)

21631 NEUTRON ACTIVATION ANALYSIS IN THE STUDY OF PULMONARY DISEASE: THE USE OF AN ATOMIC REACTOR AS A LABORATORY INSTRUMENT. J. H. Kennedy, W. F. Bethard, R. A. Schmitt, and D. A. Oleby (San Diego County General Hospital, Calif.). J. Thoracic Cardiovascular Surg., 44: 570-6(Nov. 1962).

A neutron activation method, as applied to the detection of foreign elements in human lung, is described; results relating to findings of As, Sb, and Si are reported and its use for detection of other elements outlined. Fresh specimens of lung tissue were placed in polyethylene vials and kept in the frozen state until analysis. The vials were then placed in methylmethacrylate tubes and inserted in the rotary specimen rack of the reactor. A standard sample of the element being studied was irradiated at the same time. For As the reaction is: $As^{75}(n,\gamma)As^{76}$ (half-life 26.7 hr).

Exposure of samples to a neutron flux of 1.8×10^{12} N/cm^2/sec provides saturation limits of detection of 0.005 μg As. In this case, specimens and a standard solution containing 1 μg As were irradiated for 1 hr at 250 kw. The specimens were then withdrawn from the reactor and stored overnight in appropriate Pb shielding in order to allow for the decay of Na and Cl. The chemical separation of metallic As is outlined in detail. The results of analysis of cancerous and noncancerous lung in smokers and nonsmokers for As by low beta counting suggest relative concentration of As in trace amounts by neoplastic or inflamed lung tissue without relation to tobacco use. Antimony, coprecipitated with As in the analysis, was also present in increased amounts in the neoplastic tissue but not in uninvolved lung. Other elements, that can be quantitated by neutron activation analysis and the limits of their detectability are listed. By this technique it was also possible to exclude the diagnosis of silicotuberculosis in a patient with a known industrial exposure to SiO_2. The significant advantages to the method are extreme sensitivity, freedom from reagent contamination, relative speed, and, in some cases, nondestructive analysis of the sample. (TCO)

21632 ON A METHOD ON ENRICHMENT AND SEMIQUANTITATIVE EMISSION SPECTRAL ANALYTIC DETERMINATION OF TRACES OF RARE EARTHS IN CALCIUM FLUORIDE. Kurt Rossmanith (Universität, Vienna). Mikrochim. Acta, No. 6, 1095-1100(1962). (In German)

A chemical accumulation method was developed with which the earth traces are first separated from the accompanying elements and then assembled in zinc oxide as carrier. This procedure makes possible the spectral analytical determination with high sensitivity. When the accumulation ratio is 1:100, the sensitivity limits are 5 to approximately 0.1 ppm depending on the earth. The reproducibility, particularly below 10 ppm, corresponds at present to about that of a semiquantitative procedure. (auth)

21633 DETERMINATION OF FLUORINE TRACES BY ACTIVATION IN THE REACTOR. W. Leonhardt (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 45-6(Jan. 1963). (In German)

The determination of F in electrolytically refined Ti by exposure to reactor radiation was described. The Ti crystals, packed in polystyrene ampules together with NH_4HF_2 standards, were irradiated for 3 to 10 hrs. The irradiated samples were corroded by HF–HCl mixtures, dried, weighed, and dissolved in a mixture of HCl and standardized HF. The further processing included precipitation of the fluoride as CaF_2, distillation of fluorine as H_2SiF_6, precipitation of PbClF in the distillation collector, measurement of the γ radiation of F^{18}, and determination of the chemical yield. The tabulated results show that the lower limit for the quantitative determination is 3 μg F. The limits for F determination could be improved without great effort. (J.S.R.)

21634 CONTRIBUTION TO THE EMISSION SPECTROGRAPHIC TRACE ANALYSIS IN URANIUM OXIDE. I. Janda, I. Schausberger, and E. Schroll (Studiengesellschaft für Atomenergie, Vienna). Mikrochim. Ichnoanal. Acta, No. 1, 122-30(1963). (In German)

A study was made of the sensitivity of the emission spectrographic double arc analysis of trace elements in U_3O_8 with additions of Li_2CO_3, PbF_2, and NaCl. Li_2CO_3 is especially suitable for the detection of elements with low-boiling oxides such as Pb, Ag, Cd, Ga, Ge, In, Pb, Sn, Sb, Tl, and Zn. The addition of PbF_2 favors the volatilization among others of B, Be, Al, and Si. The addition of NaCl permits the sensitive trace detection of elements with low-boiling oxides as well as of several elements which do not volatilize so readily, which form volatile chlorine compounds, for example Fe, CO, Ni, V, and Mo. Detection limits as low as 0.01 ppm were obtained with prism spectrographs. (auth)

21635 ACTIVATION ANALYTIC DETERMINATION OF IMPURITIES IN ALUMINUM. PART I. DETERMINATION OF MANGANESE AND GALLIUM. W. Kiesl, H. Bildstein, and H. Sorantin (Studiengesellschaft für Atomenergie GmbH, Vienna and Universität, Vienna). Mikrochim. Ichnoanal. Acta, No. 1, 151-6(1963). (In German)

A study was made of the activation analytical determination of manganese and gallium with gamma spectrometric measurement. A rapid and selective extraction method is given for manganese in which the permanganate ion is extracted with tetraphenylarsonium ion and chloroform. After the manganese activity has died away, the gallium can be determined gamma spectrometrically without interference. (auth)

21636 A RAPID METHOD FOR PRASEODYMIUM BY 14 Mev NEUTRON ACTIVATION. APPLICATION OF γ-γ COINCIDENCE METHOD TO THE RAPID DETERMINATION OF PRASEODYMIUM. Isao Fujii (Tokyo Shibaura Electric Co.), Akira Tani, Haruo Muto, Kazuyuki Ogawa, and Masashi Sato. Nippon Genshiryoku Gakkaishi, 5: 218-24(Mar. 1963). (In Japanese)

An analytical method is described for the rapid determination of praseodymium in samples which contain neodymium or other rare earth elements by means of activation with 14-Mev neutrons. The instrument used is made up of three-channel pneumatic system, Cockcroft-Walton design 14-Mev neutron generator, and measuring system of the annihilation γ rays of positrons emitted from Pr^{140} by the coincidence method. At a praseodymium level of 0 to 20%, the accuracy of the method is ±3% and is comparable with that of the conventional method such as photometric or gravimetric method. (auth)

21637 GAMMA MONITOR TO RAPIDLY ASSAY PLUTONIUM IN PROCESS WASTES. F. Elliott and G. W. Pearson (United Kingdom Atomic Energy Authority, Windscale and Calder Works, Seascale, Cumberland, Eng.). Nucleonics, 21: No. 5, 78; 80-1(May 1963). (PG-Report-278)

A rapid, nondestructive method that uses gamma spectroscopy to count the 0.4-Mev gamma emission from Pu^{239} is described. The equipment response is linear up to 50 g, and a detection limit equivalent to 200 mg of plutonium is readily achieved. Radiochemical determination of plutonium recovered from waste material that was previously assayed on the monitor shows the instrument to be accurate to ±30%. (C.E.S.)

21638 A SIMPLE METHOD FOR THE ANALYSIS OF I^{131}-LABELED CIRCULATING THYROID HORMONES. Balogh Iren Remenarne and P. Kertai. Orv. Hetilap, 102: 2141-2(Nov. 5, 1961).

21639 GRAVIMETRIC DETERMINATION OF ZIRCONIUM BY MEANS OF THIOSALICYLIC ACID. I. Dema. Rev. Chim. (Bucharest), 12: 231-2(1961).

A method for determining Zr^{4+} was developed based on Zr precipitation by thiosalicylic acid (I) from nitric acid medium, as a white insoluble precipitate of variable composition; subsequently, the precipitate is calcined to ZrO_2. The solution to be analyzed (6 to 60 mg Zr) is diluted with H_2O to 50 to 100 ml, HNO_3 is added (up to 0.01%), and heated up to 70 to 80°C, a solution of (I) in excess (4 g(I) in

100 ml of 96% ethanol) is added, and the whole is boiled for 5 min. 30 min later the precipitate is filtered off, washed with hot H_2O containing 1 to 2 drops of HNO_3, calcined to ZrO_2, and weighed. UO_2^{2+}, Al, Sc, Y, La, Ce, Pr, Sm, Rh, Be, Ca, Sr, Ba, Co, Ni, Mg, Zn, Ti, $PtCl_6^{2-}$, VO_3^-, MoO_4^{2-}, and WO_4^{2-}, as well as a great quantity of chlorides and nitrates, do not interfere with the Zr determination. Th^{4+}, Fe^{3+}, Bi^{3+}, Pb^{2+}, Cd^{2+}, Hg^{2+}, Pd^{2+}, and Ag^+ also form precipitates under the same conditions: SO_4^{2-}, F^-, ethylenediaminetetraacetate, tartaric, and citric acids, as well as oxidizers, prevent the determination. The method yields sufficiently accurate results. (Referativnyy zhurnal, Khimiya, No. 6, 1962).

21640 DETERMINATION OF Fe^{55} AND Fe^{59} MIXTURES IN BLOOD BY LIQUID SCINTILLATION COUNTING. H. Jenner and K. J. Oebrink (Uppsala Univ.). Scand. J. Clin. Lab. Invest., 14: 466-70(1962).

Iron-55 and Fe^{59} were determined simultaneously in blood samples after the organic material had been destroyed by nitric and perchloric acids. The Fe was precipitated as hydroxide, dissolved in oxalic acid and electroprecipitated on a platinum rod. It was then dissolved as perchlorate, the solution evaporated to a small volume and added to a solution of diphenyloxazole in toluene and absolute ethanol. The activity was determined in a single photomultiplier tube liquid scintillation counter by means of pulse height analysis. The accuracy of the method (standard deviation) was 3.4%. Slightly more than 1.3% of the error was the combined standard error due to countering statistics, and the remaining 2% due to chemical, technical, and instrumental errors. The possible influence of different amounts of total Fe in the sample was also examined, because quenching by Fe might have caused a spectrum shift. In samples containing 2.5 to 20.0 mg stable Fe in addition to identical amounts of Fe^{55} and Fe^{59}, no evidence of such an effect on the results was detected. (TCO)

21641 DETERMINATION OF BORON IN ZIRCONIUM AND ZIRCALOY. Eugene N. Pollock and Lawrence P. Zopatti (Nuclear Metals, Inc., Concord, Mass.). Talanta, 10: 118-20(Jan. 1963). (In English)

The sample is dissolved in methanol and bromine. Boron is distilled out and collected in sodium hydroxide and methanol, then determined spectrophotometrically as the carminic acid complex. (auth)

21642 ION-EXCHANGE STUDY OF THIOCYANATO-CHLORO COMPLEXES OF RARE EARTH ELEMENTS. Hiroshi Hamaguchi, Rokuro Kuroda, and Naoki Onuma (Tokyo Kyoika Univ.). Talanta, 10: 120-6(Jan. 1963). (In English)

The ion-exchange behavior of several rare earths, La, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Er, and Lu, on Diaion SK-1 cation-exchange resin with ammonium thiocyanate-hydrochloric acid solutions was studied. The distribution coefficient (Kd) of the rare earth elements decreases with increasing atomic number. The differences in Kd value were found to permit separation of the lighter rare earths. The composition of the complex in the ammonium thiocyanate-hydrochloric acid medium is likely to be $M(SCN)_2Cl$ or a similar compound, where M is the appropriate rare earth metal. (auth)

21643 THE ANALYSIS OF BERYLLIUM AND BERYLLIUM OXIDE. VII. DETERMINATION OF NICKEL. James O. Hibbits (General Electric Co., Cincinnati) and Silve Kallmann. Talanta, 10: 181-8(Feb. 1963). (In English)

A method is described for the determination of nickel in beryllium or beryllium oxide. Nickel is precipitated with benzotriazole using cadmium as a carrier. A further separation from other elements is made by passing a hydrochloric acid-isopropyl alcohol solution through Dowex-1 anion-exchange resin. If necessary, separation of nickel from manganese is made by chloroform extraction of the nickel dimethylglyoxime complex. Nickel is finally determined as the dimethylglyoxime complex in an aqueous medium. The method is accurate to ±3% relative or 3 μg of nickel, whichever is greater, and is essentially specific for the determination of nickel. (auth)

21644 THE DETERMINATION OF MICROGRAM QUANTITIES OF ZIRCONIUM IN IRON, COBALT AND NICKEL ALLOYS BY X-RAY FLUORESCENCE. Owen H. Kriege and Joseph S. Rudolph (Westinghouse Research Labs., Pittsburgh). Talanta, 10: 215-20(Feb. 1963). (In English)

Microgram amounts of zirconium are separated from iron, cobalt, nickel alloys by precipitation with p-bromomandelic acid, following which the zirconium is determined by x-ray fluorescence. Replicate results are reported for metal samples containing 0.003 to 0.5% of zirconium. An evaluation of the accuracy of this procedure was made using National Bureau of Standards certified samples. (auth)

21645 THE DETERMINATION OF TRACES OF SELENIUM AND TELLURIUM IN SAMPLES OF PLATINUM BY NEUTRON-ACTIVATION ANALYSIS. D. F. C. Morris and R. A. Killick (Brunel Coll., London). Talanta, 10: 279-85 (Mar. 1963). (In English)

A method is described for the determination of submicrogram amounts of selenium and tellurium in platinum by neutron-activation analysis. After a sample has been irradiated in a nuclear reactor, known amounts of tellurium and selenium carriers are added and a chemical separation of the elements is made. The activities of Te^{127} and Se^{75} isolated from the samples are then compared with corresponding activities separated from comparators irradiated simultaneously with the samples. The results obtained on 7 batches of pure platinum are reported. (auth)

21646 A NEW PRINCIPLE OF ACTIVATION-ANALYSIS SEPARATIONS. I. THEORY OF SUBSTOICHIOMETRIC DETERMINATIONS. Jaromír Růžička and Jiří Starý (Faculty of Nuclear Physics, Prague). Talanta, 10: 287-93 (Mar. 1963). (In English)

Separation procedures in the activation analysis of elements mainly consist of many steps which are usually derived from classical analysis schemes. In all cases of reagent (precipitating, complexing, etc.) is used for separation of the element to be determined. Separations by means of a smaller amount of reagent than corresponds to the stoichiometric ratio of element to be determined are discussed. The use of an insufficient amount of the reagent has two advantages: greater selectivity (possibility of eliminating many steps) and elimination of the necessity for determining the chemical yield of the element in question. As a result the analysis is more rapid. (auth)

21647 STUDY ON RAPID ANALYSIS BY RADIOACTIVATION. IV. DETERMINATION OF VANADIUM IN PETROLEUM. Fumio Aoki and Minoru Okada. Tokyo Kogyo Shikensho Hokoku, 58: 49-53(Feb. 1963). (In Japanese)

A neutron activation analysis method was devised for the determination of vanadium in petroleum. The possible interferences of diverse elements were examined theoretically on the basis of nuclear data for thermal neutron activation of all naturally occurring elements, and it was

anticipated that vanadium in petroleum could be determined without chemical separation. In the experiment, a sample (0.04 to 0.12g) was irradiated in the nuclear reactor JRR-1 for 3 minutes with neutrons at a flux of about 4×10^{10} neutrons per sq cm per second, and mounted in a 2 inch thick, well-type sodium iodide crystal attached to a 256-channel pulse height analyzer. The induced activity was then measured for 1 minute and the resultant gamma spectrum shown on the monitor (Braun tube) was photographed. After 1 minute-standstill of counting operation, the second counting was made for another 1 minute and the resultant gamma spectrum was photographed. Though the range of vanadium content which could really be determined was 1 to 90 ppm, it might well be deduced that the range of vanadium content to which this method could be applied was 10^{-1} to 10^{3} ppm. The coefficient of variation of single analysis for 10 ppm of vanadium was estimated, from related experimental data, at lower than 3% for 0.5 g of petroleum. (auth)

21648 STUDY ON RAPID ANALYSIS BY RADIOACTIVATION. V. DETERMINATION OF SILVER WITH THE HELP OF SILVER-110. Minoru Okada. Tokyo Kogyo Shikensho Hokoku, 58: 54-7(Feb. 1963). (In Japanese)

Neutron activation analysis was applied to the determination of silver. After a sample was irradiated in the nuclear reactor JRR-1 at a neutron flux of about 3×10^{11} neutrons per sq cm per sec for 30 sec, γ scintillation spectrometry was employed. The coefficient of variation of single analyses for 1 μg of silver was less than 3%. Contents of 1 ppm of silver in lead, 1 to 15 ppm in bismuth, and 22 ppm in zinc sulfide were determined. (auth)

21649 BASIC STUDY ON ACTIVATION ANALYSIS. II. GAMMA-RAY SPECTRA OF SHORT-LIVED NUCLIDES PRODUCED BY NEUTRON IRRADIATION. Minoru Okada. Tokyo Kogyo Shikensho Hokoku, 58: 64-75(Feb. 1963). (In Japanese)

The gamma spectra of 26 nuclides produced by neutron irradiation were collected with the intention of applying them to rapid activation analysis. The half lives of nuclides chosen are in the range from 1 sec to 5.5 min. A scintillation detector which had a well-type NaI crystal, 2 inch thick, was used. Besides the spectrogram for each nuclide, such information as the amount of material taken for irradiation, irradiation time, cooling time, counting time, absolute scale of the ordinate of the spectrogram, etc. are given through some of them are semi-quantitative. (auth)

21650 PERMANGANATOMETRIC METHOD FOR DETERMINING COLUMBIUM, WITH THE USE OF 8-HYDROXYQUINOLINE AS PRECIPITATING AGENT. A. A. Mambetov and N. A. Rzaeva. Tr. Azerb. Sel'skokhoz. Inst., 11: 75-86(1960).

Conditions for the precipitation of Nb in the form of hydroxyquinolate from solutions of the tartaric acid complex were established. The solutions were prepared from carbonate or pyrosulfate melts, as well as from a sulfuric acid niobium pentoxide solution. The reproducibility and duration of oxidation of hydroxyquinoline (I) with permanganate in sulfuric acid medium were examined, and the equivalent of (I) in the reaction was determined. Optimum conditions for the dissolution of niobium hydroxyquinolate in H_2SO_4 and for the titration of the solution with 0.02 N $KMnO_4$ solution were established. The permanganatometric method was found to be most convenient and most accurate for the determination of small amounts of Nb (5 to 50 mg) in a small volume of solution (25 to 30 ml). (Referativnyy zhurnal, Khimiya, No. 23, 1961).

21651 AMPEROMETRIC TITRATION OF URANIUM. E. P. Zyabkina and S. V. Aver'yanov. Tr. Leningr. Tekhnol. Inst. im. Lensoveta, No. 55, 172(1961).

Methods for amperometric titration of U by means of solutions of KH_2PO_4 and m-nitrophenyl arsonic acid are suggested. The effects of Al, Mg, Ba, Ca, and Fe, as well as of the pH of the solution and of a change in the medium (nitric or acetic uranyl solution) on the determination of U by the methods, were studied. (Referativnyy zhurnal, Khimiya, No. 6, 1962).

21652 POLAROGRAPHIC DETERMINATION OF URANIUM AND THE USE OF ITS CATALYTIC EFFECT UPON THE NITRATE-ION WAVE FOR THESE PURPOSES. S. P. Shaykind, S. V. Solov'eva, and S. A. Smiryagina. Tr. Leningr. Tekhnol. Inst. im. Lensoveta, No. 55, 172(1961).

The possibility of a polarographic U determination on chloride, nitrate, and carbonate backgrounds is considered, and a method is proposed to determine trace amounts of U. It is based on the catalytic action of U upon the polarographic wave of NO_3^-. One drop of KNO_3 solution (1×10^{-3} g/ml) and 2 drops of 0.5% gelatin solution are added to the solution to be analyzed, which is 0.1 N with respect to KCl and 0.01 N with respect to HCl and contains $\geq 2.5 \times 10^{-6}$ g/ml U. Then, N_2 (or H_2) is passed through, and the polarogram is taken. (Referativnyy zhurnal, Khimiya, No. 6, 1962).

21653 POLAROGRAPHIC DETERMINATION OF THORIUM. S. P. Shaykind, A. I. Alekhina, and L. T. Danilov. Tr. Leningr. Tekhnol. Inst. im. Lensoveta, No. 55, 173(1961).

An indirect polarographic method for Th determination (2×10^{-4} to 5×10^{-6} moles/l) is proposed, based on Th precipitation as 4 $Th(IO_3)_4 \cdot KIO_3$, treatment of the precipitate with alkaline solution (to transfer IO_3^- into the solution), and polarographing of IO_3^- in the alkaline solution. The wave height is directly proportional to the IO_3^- concentration in the range 5×10^{-4} to 5×10^{-6} moles/l. (Referativnyy Zhurnal, Khimiya, No. 6, 1962).

21654 RADIOACTIVE DETERMINATION OF URANIUM IN FOUR-COMPONENT SAMPLES. A. G. Vetrov. Vopr. Rud. Geofiz., Min. Geol. i Okhrany Nedr SSSR, No. 2, 102-4 (1961).

The sensitivity of the $\beta-\gamma$ method for the determination of U in ores in the presence of different amounts of Ra, Th, and K was improved by the introduction of an additional measurement of β-radiation, passing through on a 0.5-mm Al screen. A 10-mm thick layer of the powdered sample, weighing 80 to 120 g, is placed in a cylindrical container 30 mm in dia and 100 mm high, and the radioactivity is measured with a counting tube. The U content (in 10^{-4}%) is $X = 1.71\,I_2 - (1.603 + 2.41\,P_0/P_x)I_3 - 0.302I_2 + 2.41(P_0/P_x)I_f$, where I_1, I_2, and I_3 are counting rates, obtained during measurement with the counting tube screened by paper, 0.5 mm Al, or 2 mm brass screen, respectively. I_f is the background counting rate; P_x and P_0 are weights of the sample and of the standard of specific gravity 1.25. The sensitivity of the method is 0.001 to 0.0015%. The error at the sensitivity threshold is ±4 to 5×10^{-4}%. (Referativnyy Zhurnal, Khimiya, No. 5, 1962).

21655 A COMPARATIVE STUDY OF CERTAIN REAGENTS FOR THE PHOTOMETRIC DETERMINATION OF BERYLLIUM. V. I. Kuznetsov, L. I. Bolshakova, and Ming-oeh Fang (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Analit. Khim., 18: 160-5(Feb. 1963). (In Russian)

A comparative study was made of 16 reagents for

determining Be. The reagents 8-hydroxynaphthalene-3,6-disulfonic acid-(1-azo-1)-2-hydroxy-4-diethylaminobenzene (Beryllon III) and benzene-2-arsonic acid-(1-azo-2)-1-hydroxynaphthalene-6-iminodiacetic-2-sulfonic acid (Beryllon IV) are recommended as especially suitable for the photometric determination of Be. The synthesis of Beryllon III and Beryllon IV reagents is described. (auth)

21656 STUDY OF THE INTERACTION OF YTTRIUM WITH BORON–PYROCATECHOL VIOLET COMPLEX. L. S. Serdyuk and U. F. Silich (Dnepropetrovsk State Univ., USSR). Zh. Analit. Khim., 18: 166-71(Feb. 1963). (In Russian)

A boron–pyrocatechol violet complex formed by the reaction between the boric acid excess and pyrocatechol violet was used for the photometric determination of Y in the presence of La and Ce. The method is based on the difference in the stability of the boron–pyrocatechol violet complex and of the complexes of La and Ce. The composition and the instability constant of the Y complex were established. (auth)

21657 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM AND TANTALUM WITH 1-(2-PYRIDYLAZO)-RESORCINOL. I. P. Alimarin and Hsi-i Han (Moscow State Univ.). Zh. Analit. Khim., 18: 182-8(Feb. 1963). (In Russian)

A study was made of the reaction between Nb and Ta and 1-(2-pyridylazo)-resorcinol (PAR) in the presence of tartaric, citric, and oxalic acids. It was found by the isomolar series method that the Nb(Ta)/PAR ratio is equal to 1 : 1. The equilibrium constants of the formation of complex compounds are 7.3×10^6 for Nb and 8.8×10^5 for Ta. A new spectrophotometric method was developed for the determination of Nb in the presence of Ta, Ti, and Zr, and of Ta in the presence of Nb, Ti, and Zr. (auth)

21658 NEW PHOTOMETRIC METHODS FOR THE DETERMINATION OF NIOBIUM AND TANTALUM IN METALS AND ALLOYS. COMMUNICATION 1. PHOTOMETRIC DETERMINATION OF NIOBIUM BY MEANS OF 1-(2-PYRIDYLAZO)-RESORCINOL. S. V. Elinson and L. I. Pobedina. Zh. Analit. Khim., 18: 189-95(Feb. 1963). (In Russian)

At pH5, Nb forms a crimson complex with hydrogen peroxide and 1-(2-pyridylazo)-resorcinol (PAR), which may be used for the photometric determination of Nb. The absorption maximum of the complex is at 590 mμ (the pure reagent absorbs at 420 mμ). It was established by the method of isomolar series that Nb reacts with PAR in the presence of H_2O_2 at the ratio of 1 : 1. The molar extinction coefficient is about 32,300, and the equilibrium constant of the reaction is 5.52. The effect of H_2O_2, complexone III, and other masking substances on the optical density of the complex was studied. A photometric method was developed for the determination of Nb in Zr- and Ti-base alloys. The sensitivity of the method is 5 μg in 50 ml of solution. The accuracy of the method is characterized by the mean quadratic error, which is 2 to 4% at the Nb concentration in the alloy of 0.1 to 1%. (auth)

21659 DETERMINATION OF NIOBIUM AND TITANIUM AS TRIPLE COMPLEXES WITH PHOSPHOMOLYBDIC ACID. Yu. F. Shkaravskii (Kiev Inst. of General and Inorganic Chemistry). Zh. Analit. Khim., 18: 196-201(Feb. 1963). (In Russian)

The effect of oxalate, citrate, complexone III, fluoride, phosphate, and acidity on the stability of phosphomolybdic, phosphotitanomolybdic, and phosphoniobomolybdic complexes was studied. It was established that a colorless phosphomolybdic reagent with MoO_4: PO_4 = 2 at pH 1 quantitatively forms yellow heteropolycomplexes with Ti and Nb. The sensitivity of the reaction is 5 μg of Ti or 10 μg of Nb in 25 ml of solution. Niobium was determined in the presence of Ti on the basis of more rapid destruction of the phosphotitanomolybdic complex with fluoride followed by the extraction of the remaining phosphoniobomolybdic complex with 1-butanol. It was found that Ta does not give any yellow color with the phosphomolybdic reagent. A method is suggested for the determination of Nb in the presence of Ta. (auth)

21660 DETERMINATION OF OXYGEN IN INDIUM, GALLIUM AND THEIR ALLOYS. N. M. Vasileva, N. F. Litvinova, and Z. M. Turovtseva (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Analit. Khim., 18: 250-4(Feb. 1963). (In Russian)

A method for determining O in In, Ga, and their alloys was developed. The sensitivity of the method is 1×10^{-3}% (wt). It was established that O is distributed irregularly in the 2 metals. (auth)

21661 A RAPID METHOD FOR THE QUANTITATIVE DETERMINATION OF Gd^{3+} IN RARE EARTH SALT SOLUTIONS. N. S. Garif'yanov, R. K. Mazitov, and N. F. Usacheva (Kazan State Univ.). Zh. Analit. Khim., 18: 283-4(Feb. 1963). (In Russian)

A rapid method was developed for the quantitative determination of Gd^{3+} in rare earth salts at room temperature by means of a signal of the electronic paramagnetic resonance. The method permits the detection down to 2×10^{-8} gram-ions of Gd^{3+}. The quantitative determination of Gd^{3+} is possible only at concentration of more than 0.001 M. (auth)

21662 METHOD AND MEANS FOR THE DETECTION OF FISSION PRODUCTS IN FLUIDS. M. V. Wilson (to Plessey Co., Ltd.). German Patent DAS 1,144,854. Mar. 7, 1963. Priority date, June 19, 1959, Great Britain.

The method described for detecting fission products in a fluid carrier medium comprises the steps of scrubbing the fluid with a carrier gas phase so as to produce within the carrier gas phase gaseous fission products, subjecting the carrier gas phase to an electrostatic field, thereby to precipitate ionized daughter products of the fission products, transferring the precipitated solid active daughters to a second fluid carrier medium, which carries them to a radiation detection device. The means described consist of two plates spaced apart, across the surfaces of which the first and second fluid carrier mediums are arranged to flow. There are means for producing an electrostatic field between the plates and for passing a gaseous medium between the plates parallel to the surfaces of the plates. (Gmelin Inst.)

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Refer also to abstracts 21824, 21825, 21831, 21834, and 22157.

21663 (AERE-R-4253) THE NITRIDES AND SULPHIDES OF URANIUM, THORIUM AND PLUTONIUM: A REVIEW OF PRESENT KNOWLEDGE. R. M. Dell and M. Allbutt (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1963. 50p.

Information on the chemical and physical properties of the nitrides and sulfides of U, Th, and Pu is presented. Literature published before the end of 1962 is the basis of the information. (auth)

21664 (AERE-R-4281) POLYMERS OF HEAVY METALS WITH DIALKYLPHOSPHORIC ACIDS. C. J. Hardy and J. M. Fletcher (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Harwell, Berks, England). Mar. 1963. 5p.

The soluble complexes formed with alkylphosphoric acids by low concentrations of metallic cations such as UO_2^{2+}, Fe^{3+}, and Zr^{4+} are replaced by insoluble polymers at high concentrations of the cations. Likely compositions for these polymers are discussed. (auth)

21665 (ASD-TDR-62-203(Pt.II)) KINETICS OF OXIDATION OF REFRACTORY METALS AND ALLOYS AT 1000°–2000°C. J. B. Berkowitz-Mattuck (Little (Arthur D.) Inc., Cambridge, Mass.). July 1962. Contract AF33(616)-6154. 107p.

An apparatus is described for continuous measurement of the rate of oxidation of metallic materials at temperatures between 900 and 2100°C. Quantitative results obtained by the technique for the oxidation of Cu between 975 and 1044°C at oxygen partial pressures of 2 to 10 mm are in good agreement with previously reported values. For the highest carbides of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W, the results of calculations of the pressures of CO and CO_2 over an equilibrium mixture of metal carbide and the corresponding metal oxide are given along with maximum temperatures for oxidation resistance. HfC was found to be the most promising refractory carbide. The oxidation of Mo_3Si, Mo_5Si_3, and $MoSi_2$ at 1300 to 2100°K and oxygen pressures of 2 to 20 torr was studied by oxygen consumption and metallographic techniques. The oxidation of W_5Si_3 and WSi_2 was studied by the thermal conductivity method at temperatures between 1600 and 2030°C. A measurement of the rate of oxygen consumption of Ta_2Be_{17} was made at 1664°K and an oxygen partial pressure of 8.4 torr. (P.C.H.)

21666 (BM-RI-6240) THERMODYNAMIC PROPERTIES OF BERYLLIUM SULFATE FROM 0° TO 900°K. A. R. Taylor, Jr., T. Estelle Gardner, and D. F. Smith (Bureau of Mines. Tuscaloosa Metallurgy Research Center, Ala.). Oct. 1962. 10p.

Heat capacity and enthalpy values were determined for beryllium sulfate ($BeSO_4$) from 10 to 300°K in an adiabatic calorimeter, and 350 to 860°K in a Bunsen-type ice calorimeter. The heat-capacity data were extrapolated to 0°K, and smooth values of heat capacity, entropy, enthalpy function, and free-energy function were reported at 10-degree intervals between 0 to 300°K. The method of least squares was used to fit the enthalpy data with an algebraic equation. The equation also was used to calculate values of heat capacity, entropy, enthalpy function, and free-energy function at 50-degree intervals between 300 and 900°K. (auth)

21667 (HW-70543) THE PHOTOACTIVATED REDUCTION OF URANIUM(VI) TO URANIUM(IV) NITRATE. J. L. Carroll, R. E. Burns, and H. D. Warren (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1961. Contract AT(45-1)-1350. 35p.

The effects of reductant used, reductant concentration, U concentration, radiant energy intensity, acidity, temperature and nitrite suppressors on the photoactivated reduction of uranyl nitrate to uranium(IV) nitrate were studied. A practical source of radiant energy for the reduction is the GE UA-11 chemical processing lamp. Under optimum conditions, one of these lamps should be capable of producing 12 to 15 pounds of U(IV) per day. Lamp-power-reagent cost calculations indicate that U(IV) can be produced at less than 10 cents per pound. The photoactivated reduction appears applicable on either a batch or a continuous basis. Greater reduction rates were obtained with formaldehyde as the reducing agent than with hydrazine, methanol, formic acid, sulfamic acid or urea. However, more work was done to find optimum conditions for the use of formaldehyde than for the other reductants. No advantage was gained by the use of nitrite suppressors such as sulfamic acid, hydrazine or urea. The effects of other variables were, in general, as predicted from a consideration of the reactions involved. (auth)

21668 (KAPL-2216) PHASE EQUILIBRIA IN THE BORON CARBIDE–SILICON CARBIDE SYSTEM. D. R. Secrist and F. H. Guzzetta (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 5, 1962. Contract W-31-109-eng-52. 22p.

The boron carbide–silicon carbide system is quasi-binary and contains a eutectic of composition 70 ± 2 wt % B_4C and 30 ± 2 wt % SiC at a temperature of 2300 ± 20°C. The solid solubility of both B_4C in SiC and SiC in B_4C is <2 wt % at this temperature, based on metallographic and x-ray analyses. The SiC corresponds to the hexagonal (α) allotrope when the compositions contain >50 wt % SiC. The cubic (β) form of SiC is stabilized in compositions that contain <50 wt % of SiC. (auth)

21669 (UCRL-7238) ABSORPTION SPECTRA OF VARIOUS METALLIC HALIDES AND OXIDES, ELEMENTAL CARBON, AND THE INERT GASES: A BIBLIOGRAPHY. Jean E. Senkin and M. Temple Milliken, comps. (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 1, 1963. Contract W-7405-eng-48. 99p.

Approximately 800 references are given to U. S. and foreign journals published from 1927 through 1962. (P.C.H.)

21670 (UCRL-10462) DIFFUSION OF XENON IN URANIUM MONOCARBIDE (thesis). Hagai Shaked (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Nov. 7, 1962. Contract W-7405-eng-48. 107p.

The lattice diffusion coefficient of Xe^{133} in cast uranium monocarbide was measured in postirradiation anneal experiments in the temperature range 100 to 2000°C. It was found that the diffusion coefficient of specimens consisting of large grains (700 to 1000 μ) was best approximated by $D = (1.17 \pm 0.16)10^{-6} \exp[(-54900 \pm 1200)/(RT)]$ in this range. (The units of D are cm^2/sec, and RT is in units of cal/mole.) Specimens with small grains (20 to 150 microns) exhibited the same diffusion coefficient above 1500°C. Below 1500°C results with small-grained specimens varied widely, indicating dependence on grain size and, hence, existence of appreciable grain-boundary diffusion. The specimens, which were 5 × 5-mm cylinders, were irradiated in evacuated pyrex capsules, at levels ranging between 6×10^{14} and 3×10^{15} n/cm^2. After irradiation each specimen, contained in a tungsten cup, was annealed isothermally in an induction chamber for about 12 hr. Xe^{133} released from the annealed specimen was adsorbed on charcoal at liquid nitrogen temperature. The charcoal was monitored continuously with a scintillation detector during the anneal. Total Xe^{133} content of the specimen was determined by melting the specimen and collecting the Xe on the same charcoal trap. In calculating D the "conventional" analysis, which was applied in previous experiments and in which a uniform concentration of Xe^{133} at the start of the anneal was assumed, was replaced by a new analysis. In the new analysis, account was taken of the nonuniformity in the concentration of Xe^{133} at the start of the anneal due to the recoil release during irradiation prior to the anneal. Diffusion coefficients obtained in this experiment were

lower by one order of magnitude than those obtained by others for UC particles, and higher by two-and-a-half to three orders of magnitude than those obtained for UC powders. The values of D were of the same order of magnitude as obtained for the diffusion of Xe^{133} in urania. (auth)

21671 (EURAEC-553) APPLICATION OF TRANSITORY ELECTROCHEMICAL METHODS TO THE CHEMICAL ANALYSIS OF PRODUCTS CONCERNING NUCLEAR CHEMISTRY. Quarterly Report No. 10. Quarterly Report No. 4, October 1–December 31, 1962. (Brussels. Université). Work Performed under United States–Euratom Joint Research and Development Program. Contract 018-60-7RDB. 14p. A translation.

The simultaneous use of electrochemical methods (polarography, pre-electrolysis at checked potential, and amperometer) was used to determine the reaction mechanism of the reduction of the uranium(VI) carbonate complex, the oxidation of the uranium(V) carbonate complex, and the dismutation reaction of the uranium(V) carbonate complex and its kinetic parameters. The reduction and oxidation of uranium carbonate complexes depend on ionic force and on the nature of the support ions. The true kinetic exchange constant of the reaction $U(VI) + 1\epsilon \rightleftharpoons U(V)$ is of the order of $\vec{k} = 4.5\ 10^{-4}$ cm sec^{-1}. The dismutation reaction is a complex function of composition and ionic force. All the experimental facts are consistent with the kinetic law $v = k\ [U(V)]^2\ [HCO_3^-]/[CO_3]^2$ where $K = 7.7\ min^{-1}$ for $\mu = 0.5$ and $3.9\ min^{-1}$ for $\mu = 1$. (P.C.H.)

21672 (SCL-T-480) ELECTRONIC INTERACTION DURING CHEMISORPTION OF HYDROGEN ON EVAPORATED NICKEL FILMS. R. Suhrmann, Y. Mizushima, A. Hermann, and G. Wedler. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Z. Physik. Chem. (Frankfurt), 20: 332-52(June 1959). 26p.

Transparent Ni films were deposited in an ultra-high vacuum by evaporation, and measurements were made of the electric resistance and photoelectric sensitivity during the chemisorption of hydrogen as a function of the coating. Simultaneously the equilibrium pressure was also measured. Analytical evaluation of the measurements yielded the adsorption isotherms, adsorption heats, and activation energies. The combination of the three measuring methods made it possible to decide in which form the hydrogen is adsorbed. (P.C.H.)

21673 SPECTROPHOTOMETRIC STUDY OF MIXED URANIUM(IV) CHLORO-BROMO COMPLEXES IN NITROMETHANE. Chr. Klixbuell Joergensen (Cyanamid European Research Inst., Cologne). Acta Chem. Scand., 17: 251-8(1963). (In English)

Crystalline $[P(C_6H_5)_3H]_2UBr_6$ and the similar salt of UCl_6^{2-} were prepared according to Venanzi and Day. The narrow absorption bands due to internal $5f^2$ transitions were used for detection of mixed complexes $UBr_xCl_{6-x}^{2-}$ in nitromethane solution (small amounts of alcohols destroy the octahedral symmetry of the uranium(IV)complex). The dimensionless consecutive formation constants for formation of $UBrCl_5^{2-}$ and $UBr_2Cl_4^{2-}$ by addition of $N(C_4H_9)_4Br$ to the hexachloro complex were found to be $K_1 = 0.3$ and $K_2 = 0.05$. The typical A character of U(IV) is clearly shown by chloride being bound at least 20 times stronger than bromide. The nephelauxetic ratio β is some 0.03 smaller in UBr_6^{2-} than in UCl_6^{2-}. (auth)

21674 THE CRYSTAL STRUCTURES OF THE ADDUCTS $SbCl_5 \cdot POCl_3$, $SbCl_5 \cdot (CH_3)_3PO$ AND $NbCl_5 \cdot POCl_3$. Carl-Ivar Braenden and Ingvar Lindqvist (Uppsala Univ.). Acta Chem. Scand., 17: 353-61(1963). (In English)

A further refinement of the crystal structures of $SbCl_5 \cdot POCl_3$ and $SbCl_5 \cdot (CH_3)_3PO$ is reported, together with the structure determination of $NbCl_5 \cdot POCl_3$. The three compounds are isotypic. The crystal structures of $SbCl_5 \cdot POCl_3$ and $SbCl_5 \cdot (CH_3)_3PO$ have already been determined and refined by Fourier methods. These refinements now are carried a stage further using a least-square method which is also used in the refinement of the structure of $NbCl_5 \cdot POCl_3$. (auth)

21675 THE FLUORIDE AND SULPHATE COMPLEXES OF ZIRCONIUM(IV). Sten Ahrland, Dimitrios Karipides, and Bertil Noren (Univ. of Lund, Sweden). Acta Chem. Scand., 17: 411-24(1963). (In English)

The stability constants K_1^* and K_2^* for the complex equilibria $M + HA \rightleftharpoons MA + H^+$ and $MA + HA \rightleftharpoons MA_2 + H^+$, where $M = Zr^{4+}$ and $HA = HF$ and HSO_4^-, were determined by means of cation-exchange measurements. The medium was 4 M perchloric acid and the temperature 20°C. The results are consistent with those found by Connick and McVey under somewhat different conditions, by use of a solvent extraction method. The complexes formed are very strong, as could be expected for an acceptor of small radius and high charge like Zr^{4+} in connection with F and O as donor atoms. (auth)

21676 THE HYDRATED TRIURANATES OF BARIUM, STRONTIUM, AND CALCIUM. J. M. Peters (Université, Liege). Bull. Soc. Roy. Sci. Liege, 32: 122-32(1963). (In French)

The preparation and chemical and physical properties of the hydrated triuranates of Ba, Sr, and Ca are reported. The most probable formulas for the three compounds are $BaO \cdot 3UO_3 \cdot 4H_2O$, $SrO \cdot 3UO_3 \cdot 5H_2O$, and $CaO \cdot 3UO_3 \cdot 5H_2O$. The properties of the present barium triuranate were compared with those reported by Protas and by Potdevin and Brasseur. The calcium compound has not been reported previously. (J.S.R.)

21677 STUDY OF GASES ADSORBED ON THE SURFACE OF SEALED PORES OF NUCLEAR GRAPHITES. Francois-Michel Lang and Pierre Magnier (CEA, Saclay, France). Compt. Rend., 256: 2372-5(Mar. 11, 1963). (In French)

Graphite, in a vacuum at least equal to 10^{-5} mm Hg, can be taken to 2400°C by using induction heating with a field concentrator. Because of the volatilization of a part of the solid, sealed pores are destroyed, all the gas adsorbed is released, and it can be analyzed by chromatography. (tr-auth)

21678 SIMPLE METHOD FOR THE PREPARATION OF THE NITRIDES OF THE ACTINIDE AND RARE EARTH METALS. Francois Anselin. Compt. Rend., 256: 2616-19(Mar. 18, 1963). (In French)

A new method is described for the preparation of the nitrides of the actinides and rare earths. It is based on the low-temperature reaction between nitrogen under pressure and pieces of the partially hydrated massive metal. Some properties of these nitrides after preparation and fritting are described. (tr-auth)

21679 SOLUBILITY AND COMPOSITION OF SOLID PHASES IN THE $HF-UO_3-H_2O$ SYSTEM. Yu. A. Buslaev, N. S. Nikolaev, and I. V. Tananaev (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk SSSR, 148: 832-4(Feb. 1, 1963). (In Russian)

Solubility in the $HF-UO_3-H_2O$ system was studied by an isometric method for a wide range of HF concentrations. Uranic acid prepared from uranium oxide, made by cal-

cining $UO_2(NO_3)_2$ at 400°C, was used. With 0.58 to 0.73% HF, the compound $UO_2(OH)F \cdot 0.5H_2O$ was formed, which apparently is the dimer $U_2O_5F_2 \cdot 2H_2O$. The highest solubility attained was 62.5% UO_3. The resulting solid phase was considered the dihydrate of uranyl fluoride, $UO_2F_2 \cdot 2H_2O$, which exists up to 22.85% HF. With 24.11% HF, a change in the solid phase occurred, resulting in the formation of $UO_2F_2 \cdot 2HF \cdot 4H_2O$. The region of crystallization of this phase was up to 91.40% HF. Taking into account the existence of a solid phase of this composition in a system with plutonyl fluoride, the latter compound may be considered a complex acid, $H_2(UO_2F_4) \cdot 4H_2O$. (TTT)

21680 KINETICS OF THE CATALYTIC EXCHANGE REACTION OF DEUTERIUM BETWEEN WATER VAPOR AND HYDROGEN ON VARIOUS SURFACES. M. L. Nakhmanovich, N. M. Morozov, L. G. Buadze, and M. I. Temkin (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 148: 1346-9(Feb. 21, 1963). (In Russian)

The rate of the HDO + H_2 = HD + H_2O reaction was measured on various catalyst surfaces, such as Co, Pd, Cu, Ag, Fe_2O_4, and Ni, in a circulating system under atmospheric pressure. The catalyst powders were prepared by the reduction of the corresponding oxides and their specific surface determined by the low-temperature adsorption method with N or Kr. The results obtained confirmed the validity of the equation: $\omega = k_1 p_{HDO}[(p_{H_2})/(p_{H_2O})]^m - k_2 p_{HD}(p_{H_2O})/(p_{H_2})]^{1-m}$, where ω = the reaction rate of the first reaction; p_{HDO}, p_{H_2}, and p_{H_2O} = the partial pressures of HDO, H_2, and H_2O, respectively; k_1 and k_2 the reaction rate constants in the two directions; and m = a constant between 0 and 1. The values of the constants were determined for the various catalysts. (TTT)

21681 A CIRCULATION METHOD OF IMPREGNATION OF MOLYBDENUM WITH SOME ELEMENTS. D. A. Prokoshkin and B. N. Arzamasov. Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met., 9: 177-83(1962).

Results are given of heating Mo alloys with chlorides of Si, Al, Zr, or Cr in gaseous mixtures of H. The reactions that take place on the surface of Mo during the processes are: Mo + $2AlCl_3$ + $3H_2$ → $MoAl_2$ + 6HCl, Mo + $3AlCl_3$ + $4.5H_2$ → $MoAl_2$ + 9HCl, and Mo + $0.5ZrCl_4$ + H_2 → $0.5Mo_2Zr$ + HCl. A similar process carried out with Cr did not succeed. In the circulation process the HCl generated in the chemical processes is continuously reused as it serves as a carrier of the diffusing elements to the surface of the treated metal. A description of two schemes of apparatus for the conduction of the process is given, as well as photomicrographs of the surface layers of treated Mo. (P.C.H.)

21682 A STUDY ON THE PROBABLE EXISTENCE OF POTASSIUM INDIUM ALUM WITH RADIOACTIVE NUCLEI. PART I. B. C. Purkayastha and H. B. Das (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 40: 163-8(Feb. 1963). (In English)

A distribution study with Ga^{67} and Fe^{59} as guests and potassium chrome alum and potassium aluminum alum as hosts revealed that the requisite guest ions are taken up by the host components through mixed crystal formation. The study was extended from tracer level to finite concentration of the guest ions. Constancy of λ confirms the previous finding that alums are mixed crystals forming in all proportions. Verification of the heterogeneous distribution law in case of In^{114} as guest and potassium chrome alum as host was shown both at tracer level and at finite concentration of indium. Constancy of the heterogeneous distribution factor (λ) provides a positive evidence that thus far unknown potassium indium alum does exist. The value of the partition λ (0.18) is an indication that the alum is highly soluble. Causes of failure in its isolation are discussed. Radioactive indicator thus finds an application in predicting the existence of the interesting compound which is thus far unknown. (auth)

21683 STUDIES ON THE BEHAVIOR OF SEVERAL ELEMENTS IN THE FUSED BISMUTH-FUSED SALTS SYSTEM. I. DISTRIBUTION OF SEVERAL ELEMENTS BETWEEN FUSED BISMUTH AND FUSED LiCl-KCl (EUTECTIC). Shigeru Yamagishi and Yuichiro Kamemoto (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 210-18(Mar. 1963). (In Japanese)

Distribution of Mg, Sr, Sc, La, Gd, Cr, Mo, W, Mn, Tc, Fe, Co, Pt, Cu, Ag, Zn, Cd, In, Sn, Sb, Te, and Po between fused bismuth and fused LiCl-KCl (eutectic) was investigated at 550°C in argon atmosphere. Twenty grams of pure bismuth were added to 20 g of the fused salt containing a trace amount of the element above mentioned. After the salt was contacted with bismuth for 4 hr, 1 day, 2 days, and 4 days at 550°C, about 1 g of each layer was sampled and partition coefficients [K = concentration in salt (ppm)/concentration in bismuth (ppm)] were calculated. Then a similar experiment, in which the pure salt was added to the bismuth containing a trace amount of the element, was tried. In the former and the latter experiments, K values approached the same value with time. These values are as follows: Mn, 10^5; Fe, >20; Co, >300; Cu, 7; Ag, 0.05; Zn, >2,000; Cd, >1,500. For the other elements except Po, distribution coefficients were estimated from K values obtained in the former or the latter experiment. These values are as follows: Mg, >400; Sr, >870; Sc, >190; La, $>10^5$; Gd, >2,000; Cr, >2,000; Mo, >12,700; W, >18,000; Tc, <0.08; Pt, <0.003; In, >9; Sn, <0.6; Sb, <0.003; Te, <0.05. K value of Po was 0.1 after 5 hr contacting. The relation between distribution coefficient of each element and free energy of formation of the chloride of the metal was discussed. (auth)

21684 ALUMINUM-U_3O_8 EXOTHERMIC REACTIONS. J. D. Fleming and J. W. Johnson (Georgia Inst. of Tech., Atlanta). Nucleonics, 21: No. 5, 84; 86-7(May 1963).

The exothermic aluminum-U_3O_8 reaction was investigated as a method of forming desirable metal and oxide phases along with generating enough heat to sinter or fuse these phases into refractory cermet fuel materials. The results suggest the possibility of a novel fuel-fabrication process and also affect reactor safety evaluations. (C.E.S.)

21685 THE ELECTRONIC SPECTRUM OF SCANDIUM MONOFLUORIDE. L. V. Gurvich and E. A. Shenyavskaya. Opt. Spectry. (USSR) (English Transl.), 14: 161-2(Feb. 1963).

The electron spectrum of scandium monofluoride is presented. Four groups of bands shaded toward the violet and one band system with red shading were observed. The most intense band group with a well-developed vibrational structure was located around 2880 Å. On the long-wavelength side was located a small group of bands similar to the bands of the intense group. The band groups at 2780 and 2729 Å have a simple vibrational structure. A preliminary analysis of the group of double edges with red shading in the 2880 Å region is presented. (C.E.S.)

21686 MAGNETO-OPTIC PHENOMENA IN THE ABSORPTION AND EMISSION SPECTRA OF A CRYSTAL OF CaF_2-Eu^{++}. B. P. Zakharchenya and A. Ya. Ryskin. Opt. Spectry. (USSR) (English Transl.), 14: 163-4(Feb. 1963).

An investigation of the Zeeman effect in the absorption

and emission spectra of the CaF_2-Eu^{2+} crystal is presented. The crystals were cooled to 4.2°K, and observations were made in fields of 10 to 140 k oersteds. A broadening of the line at 4130 Å, together with the appearance of weak satellites on either side of it, was observed in the absorption spectrum of crystals containing a large concentration of Eu^{2+}. A number of intense absorption bands also appear on the short-wavelength side. (C.E.S.)

21687 PARAMAGNETIC RESONANCE OF DIVALENT HOLMIUM IN CALCIUM FLUORIDE. H. R. Lewis and E. S. Sabisky (RCA Labs., Princeton, N. J.). Phys. Rev., 130: 1370-3(May 15, 1963).

The paramagnetic resonance spectrum of the ground state of divalent holmium in calcium fluoride was observed at a temperature of 4.3°K and at frequencies of 9 and 27 kMc/sec. The spectrum is isotropic and may be fitted to a spin Hamiltonian with $S = {}^1/_2$, $I = {}^7/_2$, $A = -0.1307\ cm^{-1}$, $g = -5.912$, and $G_N = +48$, where G_N is a pseudonuclear g factor. The value of g indicates that the ground state is Γ_6. The appearance of a pseudonuclear g factor, which arises because the nearest quartet state has matrix elements with the ground state, permits a determination of the energy separation to the quartet state. (auth)

21688 SECOND-NEIGHBOR EXCHANGE INTEGRAL IN EuS. Joseph Callaway and D. C. McCollum (Univ. of California, Riverside). Phys. Rev., 130: 1741-2(June 1, 1963).

Experimental measurements of the specific heat of EuS in the temperature region 1–4°K were analyzed to determine the first and second-neighbor exchange integrals. The results are: $J_1 = (1.48 \pm 0.16) \times 10^{-5}$ ev; $J_2 = (-0.11 \pm 0.28) \times 10^{-5}$ ev. (auth)

21689 ROTATIONAL MAGNETIC MOMENTS OF LITHIUM HYDRIDE AND DEUTERIDE. T. R. Lawrence, C. H. Anderson, and N. F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev., 130: 1865-70(June 1, 1963).

Resonances of the rotational magnetic moments were observed in molecular beams of lithium hydride and lithium deuteride. The shape of the LiH rotational magnetic resonance curve was observed to be asymmetric and width of the curve was observed to increase with increasing magnetic field. These effects were ascribed to centrifugal stretching causing the magnetic moment per unit of angular momentum to vary with angular momentum. The variation was assumed to be of the form, $\mu_R/J = g_0 + CJ(J+1)$, where μ_R is the rotational magnetic moment and J is the quantum number of the total rotational angular momentum. The values of the constants g_0 and C assigned to LiH were: $g_0 = -0.654 \pm 0.007$ nuclear magneton and $C = (1.2 \pm 0.6) \times 10^{-4}$ nuclear magneton. For LiD, these constants were found to be: $g_0 = -0.272 \pm 0.005$ nuclear magneton and $C = (3.4 \pm 1.7) \times 10^{-5}$ nuclear magneton. The electric dipole moment and its polarity were calculated from the rotational magnetic moments of LiH and LiD. The results of this calculation were $\mu_e = 5.9 \pm 0.5$ debyes with the polarity Li^+H^-. The magnitude of the rotational magnetic moment resonance signals suggest the occurrence of multiple-quantum transitions, which may make possible the observation of rotational magnetic moment resonances in other molecules, even if the rotational gyromagnetic ratios are quite small. (auth)

21690 POTENTIAL ENERGY CURVE FOR THE INTERACTION OF TWO XENON ATOMS. P. K. Chakraborti (Indian Assn. for the Cultivation of Science, Calcutta). Physica, 29: 227-33(Mar. 1963). (In English)

The potential energy curve for Xe–Xe interaction was determined on a six parameter model by using the crystal properties, second virial coefficient, and molecular beam scattering data for xenon. The potential energy curve thus obtained should be more realistic than the usual two or three parameter models. (auth)

21691 RATE OF EVAPORATION AND VAPOR PRESSURE OF CARBIDES, SILICIDES, NITRIDES, AND BORIDES. V. V. Fesenko and A. S. Bolgar (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 1, 17-25(Jan.-Feb. 1963). (In Russian)

The results of investigations by Langmuir's method on the rate of evaporation and the vapor pressure of carbides, borides, silicides, and nitrides are presented. It was noted that all the refractory compounds investigated were dissociated on heating in vacuum and the pressure of the vapor over the compounds was determined by both the metal vapor and the metalloid vapor pressure. It was found that for a metal the rate of evaporation increases as a rule from carbides to borides, silicides, and nitrides. (P.C.H.)

21692 INVESTIGATION OF CONDITIONS FOR PREPARING NIOBIUM CARBIDE. V. N. Paderno and Yu. K. Lapshov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 1, 75-8(Jan.-Feb. 1963). (In Russian)

Conditions for the formation of niobium carbide by the reduction of niobium pentoxide with soot in a hydrogen atmosphere and in a vacuum were investigated. The optimal conditions for obtaining niobium carbide were: heating a charge containing 97% of the calculated quantity of soot at 1700°C for one hour; and heating a stoichiometric charge twice at 1700°C in vacuum for one hour with intermediate grinding and screen-sizing of the product. The maximum bound carbon content in the resulting carbide samples corresponds to the formula $NbC_{0.98}$. (P.C.H.)

21693 TRINITRATONIOBIUM(V) OXIDE, $NbO(NO_3)_3$. B. O. Field and C. J. Hardy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Chem. Soc., 11(Jan. 1963).

The preparation, properties, and structure of $NbO(NO_3)_3$ are reported. $NbO(NO_3)_3$ was prepared by reaction of anhydrous $NbCl_5$ with liquid N_2O_5 at 30°C. The product fumes in moist air, is hydrolyzed by water, is not volatile, and begins to decompose at ~120°C. Infrared spectral and x-ray diffraction studies of the structure showed a tetragonal cell with unit parameters a = 11.92 and c = 5.33 Å and a probable Nb–O double bond (906 cm^{-1}) with bridging nitrato-groups. (D.L.C.)

21694 THERMOCHEMISTRY AND THERMODYNAMICS OF ION EXCHANGE IN A CRYSTALLINE EXCHANGE MEDIUM. R. M. Barrer, L. V. C. Rees, and D. J. Ward (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), Ser. A, 273: 180-97(May 7, 1963).

A simple, robust calorimeter was constructed and used to study the heats of exchange of the ion pairs Li ⇌ Na, K ⇌ Na, Rb ⇌ Na, Cs ⇌ Na, and Ca ⇌ 2Na in Linde sieve 4A, and parallel measurements were made of the exchange equilibria. In all cases the thermochemical and equilibrium measurements were interpreted to give standard heats of partial exchange, and standard heats, free energies, and entropies of full exchange, which are discussed in relation to the energetic heterogeneity of distribution of the cations and other factors. Heats, free energies, and entropies of mixing of the end members of the exchange to give the mixed, solid crystalline exchangers are also derived and discussed. (auth)

21695 THERMAL DECOMPOSITION OF HYDRATED URANIUM PEROXIDES. E. H. P. Cordfunke and P. Aling (Reactor Centrum Nederland, Petten, Netherlands). Rec. Trav. Chim., 82: 257-63(Mar. 1963). (In English)

The water vapor pressure of the equilibrium between the hydrates $UO_4 \cdot 4H_2O$ and $UO_4 \cdot 2H_2O$ was measured as a function of the temperature. The results can be expressed as: $\log p_{H_2O}(mm) = 11.020 - 3082/T$. Thermal decomposition of these hydrates results in the formation of amorphous (A-) UO_3, α-UO_3, or the $UO_{2.9}$ phase. These transformations were studied by thermogravimetric and differential thermal analysis. At 520° recrystallization of these oxides takes place with formation of γ-UO_3. (auth)

21696 MAGNETIC SCREENING OF THE Na^{23} NUCLEUS IN ALKALI-HALIDE CRYSTALS. V. S. Grechishkin, M. L. Zlatogorskii, and A. N. Osipenko (Gor'kii Perm State Univ., USSR). Soviet Phys.-Solid State (English Transl.), 4: 2191-2(Apr. 1963).

The magnetic shielding of Na^{23} nuclei was investigated by measuring the chemical shift of nuclear magnetic resonance (NMR) signals in alkali-halide crystals. The NMR signals from NaBr, NaCl, NaF, and NaI were observed at a frequency of 6.5 Mc. An aqueous solution of the corresponding material was used as a standard. An electromagnet that produced a magnetic field of 5800 oersteds was used. (C.E.S.)

21697 THE POLAROGRAPHY OF CERIUM^{IV} IN ACETATE BUFFER. O. P. Agrawal and R. C. Kapoor (Univ. of Allahabad, India). Talanta, 10: 316-19(Mar. 1963). (In English)

The polarographic behavior of cerium(IV) was studied in Walpole acetate buffers of different concentrations and pH values (4, 5, and 5.6). One M acetate media of pH 4 and 5 were found useful for the polarographic determination of cerium(IV). At pH 4, in 0.2M acetate medium, a second wave at −0.9 v vs. S.C.E. was observed, which had anomalous characteristics. (auth)

21698 INVESTIGATION OF THE OXIDATION STATE OF CERIUM IN HOT SULPHURIC ACID SOLUTIONS. I. Pais, E. Schulek, and M. Rozsahegyi (Eotvos Univ., Budapest). Talanta, 10: 445-8(May 1963). (In English)

The reduction of cerium(IV) in hot concentrated sulfuric acid and in sulfuric acid hydrates, respectively, is investigated. It is found that on raising the concentration of sulfuric acid, the degree of reduction also increases. The degree of reduction depends to a great extent on the relative quantities of solid substance weighed and of sulfuric acid used for the boiling treatment. In contrast to other suggested mechanisms, no correlation is found to exist between the gaseous oxygen developed during reduction and the oxygen bound by sulfuric acid. (auth)

21699 CATHODIC PROCESSES DURING THE DEPOSITION OF HAFNIUM FROM CHLORIDE AND FLUORIDE–CHLORIDE MELTS. M. V. Smirnov, A. N. Baraboshkin, N. A. Saltykova, V. E. Komarov. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural'sk. Filial, No. 2, 63-9(1961).

Cathodic polarization at D = 10^{-4} to 2 amp/cm^2 and 700 to 900°C was studied during electrolysis of chloride and chloride–fluoride melts containing Hf. Differing from Zr deposition, Hf deposition is accompanied by lesser residual currents. The introduction of F anions to the melt displaces the potential of Hf separation toward more negative values and increases concentration polarization, in particular, for the case of molar ratio [F]/[Hf] = 6. (Referativnyy zhurnal, Metallurgiya, No. 8, 1962)

21700 SOME PROCESSES IN CATHODIC DEPOSITION OF ZIRCONIUM FROM CHLORIDE–FLUORIDE MELTS. L. E. Ivanovskii and O. S. Petenev. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural'sk. Filial, No. 2, 71-8(1961).

As a result of investigating cathodic deposits, obtained by electrolysis of fluoride–chloride Zr melts, it was found that at low D (0.01 to 0.1 amp/cm^2) difficultly soluble double Zr salts of the $NaZrF_4$ or $KZrF_4$ type are formed on the cathode. At higher D, metal is also deposited, the more so as D increases. Properties and behavior of double Zr salts in the melts were investigated. Problems concerning the effect of by-processes on Zr and Hf separation in electrolysis are analyzed. (Referativnyy zhurnal, Metallurgiya, No. 8, 1962)

21701 THE UTILIZATION OF SODIUM HYPOPHOSPHATE FOR THE SEPARATION OF THORIUM FROM CERIUM. A. A. Mikhailov and E. N. Tekster. Tr. Leningr. Tekhnol. Inst. im. Lensoveta, No. 55, 167-9 (1961).

The distribution of Ce between solid and liquid phases was investigated with the help of Ce^{144}, in reactions where a 1:5 mixture of Th and Ce was precipitated from sulfuric and hydrochloric acid solutions by $Na_2H_2P_2O_6$, used in an excess of 150%. Ce^{4+} was reduced to Ce^{3+} by H_2O_2 before and after precipitation by the hypophosphate. It was established that, if Ce^{4+} is reduced before the addition of the precipitant, practically all Ce remains in sulfuric acid solution, for concentrations of H_2SO_4 ranging from 1.5 to 3.5 N, and in hydrochloric acid solution, for concentrations of HCl between 2.5 and 4 N. Proceeding from the knowledge of solubility of ThP_2O_6 in acids, it was assumed that practically all the Th is in the solid phase. Methods were worked out for the preparation of pure $Na_2H_2P_2O_6$ from red P. (Referativnyy zhurnal, Khimiya, No. 6, 1962).

21702 EFFECT OF SOLVENT CONCENTRATIONS ON THE FORMATION OF LANTHANUM AND CERIUM HYDROXIDES. N. N. Mironov and N. P. Chernyaev. Tr. po Khim. i Khim. Tekhnol., No. 3, 540-50(1961).

By measuring the solubility, pH, and electric conductivity of equilibrium solutions, it was shown that the formation of basic salts precedes the formation of La and Ce hydroxides in the systems $La_2(SO_4)_3$–NaOH–H_2O and $Ce_2(SO_4)_3$–H_2O–NaOH. Substitution of SO_4^{2-} by OH^- ions is more difficult in the basic salts of La than in those of Ce. The basic salts precipitated from dilute solutions on addition of NaOH contain, with equal molar ratios, more hydroxyl groups than those formed from saturated solutions. (Referativnyy zhurnal, Khimiya, No. 19, 1962).

21703 PROTON MAGNETIC RELAXATION IN METHANE. I. V. Matyash, O. O. Galkin, and L. M. Tarasenko (Inst. of Physics and Tech. of Low Temperatures, Khar'kov). Ukr. Fiz. Zh., 7: 38-41(Jan. 1963). (In Ukrainian)

The spin echo method was used to study the temperature dependence of the spin-lattice and spin-spin relaxation times in methane over a temperature range of 77–105°K. The activation energy is estimated for methane by the data obtained, and the correlation translation time and self-diffusion coefficients are calculated for liquid and solid methane. (auth)

21704 PHYSICAL PROPERTIES OF CERIUM SULFIDES. V. I. Marchenko and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Kiev). Ukr. Fiz. Zh., 7: 140-2(Jan. 1963). (In Ukrainian)

Experimental studies were made of CeS and Ce_2S_3 physical properties. Electric conductivity and thermal expansion as a function of temperature at 20 to 1000°C and magnetic susceptibility of Ce_2S_3 at room temperature

were studied. The obtained data were used for determining the thermal coefficients of electric resistivity and expansion. (R.V.J.)

21705 CONCERNING THE SOLUBILITY OF RARE GASES IN SEA WATER. H. Koenig (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 18a: 363-7(Mar. 1963). (In German)

The solubilities of the inert gases were measured in pure water and in sea water within the temperature range from 0 to 25°C. Comparison of the values in pure water and of the solubilities of argon in sea water with data obtained by other authors suggest that the measurements are reliable within the quoted limits of error. The behavior of the inert gases is expressed in a series of regularities which are also graphically shown. (auth)

21706 DIFFUSION IN THE SYSTEM H_2O-HDO. G. A. Andreev (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Fiz. Khim., 37: 361-5(Feb. 1963). (In Russian)

Diffusion coefficients in the system H_2O-HDO were measured at 5 to 45°C by the porous diaphragm cell method. In the temperature range 15 to 45°C, the experimental data are described by the equation $D = 2.57 \times 10^{-2} \exp(-4162/RT) cm^2/sec$. Below 10° the diffusion coefficient is less than that following from the above equation, apparently owing to the closeness of the freezing temperature. The activation energy of diffusion in dilute aqueous solutions of Li^+ and Na^+ ions is higher and for K^+, Rb^+, Cs^+, Cl^-, Br^-, and I^-, lower than for the case of water. (auth)

21707 COORDINATION NUMBER AND THE INTERATOMIC DISTANCES IN METALLIC AND COVALENT CRYSTALS. E. S. Sarkisov (Moscow State Univ.). Zh. Fiz. Khim., 37: 396-404(Feb. 1963). (In Russian)

On the basis of the development of the coordination number concept in relation to structures with metallic and covalent bonds, an equation was derived expressing the relation between the interatomic distance and the coordination number of the lattice and the electronic structure of the atoms forming the crystal. A method is proposed for assessing the metallicity or covalency of the bond in the crystal lattice with the aid of the derived equation. (auth)

21708 BASIC CHLORIDES AND GADOLINIUM HYDROXIDE. N. V. Aksel'rud (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 11-17(Jan. 1963). (In Russian)

The measurements of three variables were used for determining the composition and properties of basic chlorides and gadolinium hydroxides. The activity and isobaric-isothermic formation potentials were found. (R.V.J.)

21709 LEAD AND INDIUM SULFIDE VAPOR PRESSURE. R. A. Isakova, V. N. Nesterov, and A. S. Shendyapin (Inst. of Metallurgy and Ore Concentration, Academy of Sciences, Kazakh SSR). Zh. Neorgan. Khim., 8: 18-23(Jan. 1963). (In Russian)

The vapor pressure and sublimation of lead pressure and indium sulfides were studied at 840 to 1100 and 920 to 1360°C, respectively. The data developed by static and transfer methods for lead sulfides are expressed by the equation: $\lg p_{mm} = -11242.5/T + 10.08$; and for indium sulfides $\lg p_{mm} = -12962.5/T + 10.12$. (R.V.J.)

21710 NEW ZIRCONIUM AND HAFNIUM OXYACETATES. L. N. Komissarova, M. V. Savel'eva, and V. E. Plyushchev (Moscow State Univ. and Moscow Inst. of Fine Chemical Tech.). Zh. Neorgan. Khim., 8: 56-62(Jan. 1963). (In Russian)

The synthesis of zirconium and hafnium oxyacetate compounds $Me_2O \cdot (OH)(CH_3COO)_5 \cdot nH_2O$ or $Me_4O_3(CH_3COO)_{10} \cdot (n+1)H_2O$ was described and their properties and thermal stability were studied. The thermal decomposition schemes of zirconium and hafnium oxyacetates are given including the intermediate compounds formed. (R.V.J.)

21711 NORMAL NIOBIUM AND TANTALUM ORTHOPHOSPHATES. G. B. Seifer and I. V. Tananaev (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 63-5(Jan. 1963). (In Russian)

Preparation of normal niobium and tantalum orthophosphates $Nb_3(PO_4)_5$ and $Ta_3(PO_4)_5$ was achieved by $Nb_2O_5 \cdot xH_2O$ and $TaCl_5$ reaction with saturated crystalline H_3PO_4 and by calcination of concentrated precipitates. (R.V.J.)

21712 THERMODYNAMIC PROPERTIES OF THORIUM OXYCHLORIDE. Kung-fan Yen, Shao-chung Li, and G. I. Novikov. Zh. Neorgan. Khim., 8: 89-93(Jan. 1963). (In Russian)

Phase studies of ThO_2-ThCl_4 showed the presence of oxychloride $ThOCl_2$. The $ThOCl_2$ heat of formation is 295.4 ± 1.5 kcal/mole and thermal decomposition follows the scheme: $2[ThOCl_2]_{solid} \rightarrow [ThO_2]_{solid} + (ThCl_4)_{vapor}$. The thermodynamic characteristics of the process are $\Delta H_T = 72.5 \pm 1.5$ kcal/mole. $\Delta S_T^0 = 57.8 \pm 1.3$ S. The final heat of formation and the absolute entropy of $ThOCl_2$ are 295.6 ± 2.6 kcal/mole and 27 ± 1.3 entropy units. (R.V.J.)

21713 THERMAL AND TENSIOMETRIC STUDIES OF $NbCl_5-ZrCl_4-KCl$ SYSTEMS. I. S. Morozov, N. P. Lipatova, and A. T. Simonich (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 172-6(Jan. 1963). (In Russian)

A thermal analysis and phase study was made of the $NbCl_5-ZrCl_4-KCl$ system. Crystallization boundaries for the initial crystallization of KCl, K_2ZrCl_6, $KNbCl_6$, $ZrCl_4$, and $NbCl_6$ were found. Tensiometric analysis was made of niobium and zirconium chloride separation by volatilization in presence of potassium chloride. (R.V.J.)

21714 MELT DIAGRAMS OF $LiClO_4-Ca(ClO_4)_2$ AND $NaClO_4-Ca(ClO_4)_2$. N. V. Krivtsov and A. A. Zinov'ev (Yaroslav State Pedagogical Univ., USSR). Zh. Neorgan. Khim., 8: 186-91(Jan. 1963). (In Russian)

Melting diagrams of $LiClO_4-Ca(ClO_4)_2$ and $NaClO_4-Ca(ClO_4)_2$ were constructed. Both systems exhibit simple eutectic and polymorphous component transformation. Three polymorphous calcium perchlorate modifications were found at 342 and 406°C. (R.V.J.)

21715 PHASE EQUILIBRIUM IN $LiCl-H_2O$ AT HIGH TEMPERATURES. M. I. Ravich and L. F. Yastrebova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 202-7 (Jan. 1963).

Phase equilibrium studies of $LiCl-H_2O$ showed that at 556° the solubility of LiCl in water reaches 93.5 wt %. The maximum vapor pressure of saturated LiCl solution is considerably lower than saturated potassium and sodium. (R.V.J.)

21716 SOME ACIDOCOMPLEX URANYL COMPOUNDS CONTAINING UREA IN THEIR STRUCTURE. V. P. Markov and I. V. Tsapkina (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 285-9(Feb. 1963). (In Russian)

An analysis was made of urea reactions with complex uranyl acetate compounds. The properties of new complexes prepared were studied. (R.V.J.)

21717 ACETOFLUORIDE URANYL COMPLEXES OF PENTACIDO TYPE. V. A. Golovnya and L. K. Shubochkin (Kurnakov Inst. of General and Inorganic Chemistry, Acad-

emy of Sciences, USSR). Zh. Neorgan. Khim., 8: 290-4 (Feb. 1963). (In Russian)

Characteristics of uranyl diaquadiacetate reactions with NH_4F, KF, and NaF were studied, and the properties of synthesized mixed acetofluorine complexes were investigated. (R.V.J.)

21718 REACTIONS OF PRASEODYMIUM CHLORIDE WITH GLYCINE AND α ALANINE. O. E. Zvyagintsev and E. V. Goncharov. Zh. Neorgan. Khim., 8: 349-59(Feb. 1963). (In Russian)

Studies were made of praseodymium chloride reactions with glycine and α-alanine. Complex compounds with stoichiometric coefficients 1:1, 1:2 were found in aqueous solutions. The stability of praseodymium complexes with glycine and α-alanine increases with an increased neutralization of amino acid. (R.V.J.)

21719 TERNARY SYSTEM OF LITHIUM, POTASSIUM AND CADMIUM CHLORIDES. A. G. Bergman and Zh. V. Misler (Inst. of Scientific-Research in Machine Building Tech., Rostov District of the Council of National Economy, USSR). Zh. Neorgan. Khim., 8: 403-6(Feb. 1963). (In Russian)

Phase diagrams of the ternary system Li, K, Cd, ||Cl were prepared and eight crystallization fields were found: K_2Cl_2, Li_2Cl_2, $CdCl_2$, $3Li_2Cl_2 \cdot 2CdCl_2$, $Li_2Cl_2 \cdot CdCl_2$, $K_2Cl \cdot 2CdCl_2$, and $2K_2Cl_2 \cdot CdCl_2$, and ternary compounds converging at five eutectic and two transitional points. (R.V.J.)

21720 EXTRACTION OF CESIUM POLYIODIDES FROM AQUEOUS PHASE INTO NITROBENZENE. M. Kyrsh and S. Podesheva (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rzhizh and Zapototskii Military Academy, Brno). Zh. Neorgan. Khim., 8: 499-507(Feb. 1963). (In Russian)

The influence of pH, cesium concentration, ratio of iodine and iodide, and various cations and anions on solvent extraction of cesium polyiodide from the aqueous phase into nitrobenzene was studied. Separation of Ce from long-lived products and Ru^{4+}, Rb^+, K^+, Na^+, Ca^{2+}, and Mg^{2+} was studied and conditions for Ce re-extraction from nitrobenzene into aqueous phase were found. (R.V.J.)

21721 X-RAY STUDIES OF HAFNIUM TETRABROMIDE. S. S. Berdonosov, D. G. Berdonosova, A. V. Lapitskii, and L. G. Vlasov (Moscow State Univ.). Zh. Neorgan. Khim., 8: 531-2(Feb. 1963). (In Russian)

Preparation of $HfBr_4$ was described and its structure analyzed. The indicated $HfBr_4$ structure is a primitive cubical with a = 10.91 ± 0.01 A, and Z = 8. The pycnometric specific weight was $d_4^{25} = 4.90 \pm 0.01$ g/cm^3. (R.V.J.)

21722 FREE RADICALS IN INORGANIC CHEMISTRY. Papers presented at the Symposium on Inorganic Free Radicals and Free Radicals in Inorganic Chemistry, Division of Inorganic Chemistry, 142nd Meeting of the American Chemical Society, Atlantic City, N. J., September 10-12, 1962. Advances in Chemistry Series No. 36. Washington, D. C., American Chemical Society, 1962. 180p.

Seventeen papers are presented on the preparation, detection, properties, and reactions of inorganic free radicals. Electron-spin resonance studies are discussed together with other spectral studies. Some of the radicals considered are oxy radicals, halogen atoms, HO_2, NF_2, N_2F_4, NO_2, and O_2ClF_3. (D.L.C.)

21723 CADMIUM PHOSPHATE GLASS. H. W. Carpenter and P. D. Johnson (to U. S. Atomic Energy Commission). U. S. Patent 3,084,055. Apr. 2, 1963.

A method of preparing a cadmium phosphate glass that comprises providing a mixture of solid inorganic compounds of cadmium and phosphate having vaporizable components and heating the resulting composition to a temperature of at least 850°C is presented. (AEC)

Organic Chemistry

21724 (NP-12743) GLYCIDIC ESTERS AND/OR ORGANIC DISULFIDES, AND RELATED SUBSTANCES, AS SOURCES OF ANTI-RADIATION DRUGS. Interim Research Report No. 14, January 1, 1963– March 31, 1963. J. Buckman, R. Crenshaw, A. Ferretti, W. Lacefield, and T. Parsons (Vanderbilt Univ., Nashville). Contract DA-49-193-MD-2030. 25p.

Methods for the synthesis of bis-disulfides (RSSR'SSR), mercaptodisulfides (HSRSSR'), and related compounds are presented. The disproportionation of bis-disulfides to symmetrical disulfides was studied, and their relative stabilities were evaluated. A promising synthesis of a sodium alkanesulfinate was also developed. (P.C.H.)

21725 ISOTOPIC EXCHANGE REACTION BETWEEN AN AROMATIC SULFONIC ACID AND ITS ANHYDRIDE. N. Hesselbjerg Christensen (Danish Atomic Energy Commission, Risø, Denmark). Acta Chem. Scand., 17: 464-72 (1963). (In English)

p-Iodobenzene sulfonic acid labelled with S^{35} or I^{131} and unlabelled p-iodobenzene sulfonic anhydride in a homogeneous solution of nitromethane were observed to exchange radioactivity. The kinetics correspond to a typical first-order scheme. The rate constant of the first-order reaction is proportional to the ratio of the anhydride concentration to the acid concentration. The experimental data support the assumption that the exchange proceeds through a mechanism involving dissociation of a molecule of anhydride into a sulfonyl cation and a sulfonate anion. (auth)

21726 THE STEREOCHEMISTRY OF TRITIUM SUBSTITUTION BY THE WILZBACH METHOD. I. (–)-INOSITOL. S. J. Angyal, J. L. Garnett, and R. M. Hoskinson (Univ. of New South Wales, Kensington). Am. J. Chem., 16: 252-7(Apr. 1963).

The stereochemistry of tritiation of crystalline (–)-inositol and its liquid hexa-O-methyl derivative by the Wilzbach labeling procedure was investigated. Predominance of configurational retention was found to accompany substitution in the crystalline compound, whereas configurational inversion predominated during substitution in the liquid. (auth)

21727 SYNTHESIS OF ACETYLENE AND BENZENE LABELED WITH C^{14}. G. Bignardi, A. Reuter, and R. Demotte (Università, Genoa and Centre d'Étude de l'Energie Nucléaire, Mol, Belg.). Farmaco (Pavia), Ed. Sci., 17: 148-56(Mar. 1962).

A method for the preparation of C^{14}-labeled acetylene which involves the formation of barium carbide that is decomposed in water to yield acetylene is described. $2\,BaC^{14}O_3 + 5\,Ba \rightarrow BaC_2^{14} + 6\,BaO$; $BaC_2^{14} + H_2O \rightarrow Ba(OH)_2 + HC^{14} \equiv C^{14}H$. The labeled acetylene may then be trimerized to form benzene by the aid of triphenylphosphine nickel carbonyl. This gives a high yield of benzene (74%) and a small amount of uniformly labeled styrene (10%). A specially constructed apparatus for the preparation of barium carbide is described and illustrated. It provides for rapid synthesis in high yield with maximum safety to the operator. Preparation of the catalyst and the trimerization procedure are also described. (H.H.D.)

21728 N-(HETEROAROMATIC-SUBSTITUTED METHYL) DERIVATIVES OF 2-AMINOETHANETHIOL.

Thomas P. Johnston and Anne Gallagher (Southern Research Inst., Birmingham, Ala.). J. Org. Chem., 27: 2452-57(1962).

Several methods for the preparation of N-(heteroaromatic-substituted methyl) derivatives of 2-aminoethanethiol were investigated. The sodium borohydride reduction of Schiff bases derivable from cystamine and heteroaromatic aldehydes (for example, Ia and Ib) may have general utility for the preparation of this type of N-substituted 2-aminoethanethiol. The iodine oxidation of the thiazolidines IIa and IIb was demonstrated to be an advantageous source of the corresponding Schiff bases. The direct aralkylation of cystamine with 8-(bromomethyl)quinoline was shown to be controllable so as to give as the predominant product either a tetra- or a disubstituted cystamine (IX and X, respectively). Sulfur cleavage of the disubstituted cystamines VIa and X afforded the corresponding intra Buntė salts. (auth)

21729 COMPLEX FORMATION OF THORIUM WITH ORGANIC ACID ANIONS IN SOLUTIONS. K. B. Yatsimirskii and Yu. A. Zhukov. Zh. Neorgan. Khim., 8: 295-301(Feb. 1963). (In Russian)

Complexing of thorium with malonic, succinic, and tartaric acids in dilute solutions was studied, and stability constants for $ThCH_2C_2O_4^{2+}$, $Th_2CH_2C_2O_4OH^{5+}$, $Th_2(CH_2)_2C_2O_4^{6+}$, and $Th_2CH_2CHOHC_2O_4^{6+}$ complexes were estimated. Equilibrium constants for a reaction forming $Th(CHO)_2C_2O_4^{2+}$ were also calculated. (R.V.J.)

21730 CERTAIN SALTS OF ETHYLENEDIAMINETETRAACETATOYTTRIUM ACID. I. V. Tananaev and G. S. Tereshin (Kurnakov General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 523-4(Feb. 1963). (In Russian)

Preparation of Rb, Ca, and Sr ethylenediaminetetraacetatoyttrium acids was described and instability constants for YEDTA Ca^+ and YEDTA Sr^+ found at 25° were 0.8×10^{-2} and 1.5×10^{-2} at ionic strength 0.003, and 2.6×10^{-2} and 2.9×10^{-2} at ionic strength 0.016. (R.V.J.)

21731 ON BROMINE AND IODINE BERYLLIUM COMPLEXES WITH SIMPLE ETHERS. N. Ya. Turova and A. V. Novoselova (Moscow State Univ.). Zh. Neorgan. Khim., 8: 525-8(Feb. 1963). (In Russian)

Properties of complex compounds of beryllium bromides and iodides with aliphatic, tetrahydrofuran, and dioxane ethers were studied and their melting points found. (R.V.J.)

21732 ON THE THERMAL STABILITY OF BERYLLIUM HALIDE ETHERATES. N. Ya. Turova, N. S. Sitdykova, A. V. Novoselova, and K. N. Semenenko (Moscow State Univ.). Zh. Neorgan. Khim., 8: 528-31(Feb. 1963). (In Russian)

Thermogravimetric and tensiometric studies of $BeCl_2 \cdot 2(C_2H_5)_2O$ and $BeBr_2 \cdot 2(C_2H_5)_2O$ showed that $BeCl_2 \cdot 2(C_2H_5)_2O$ thermal decomposition starts at 55 to 60° and ends at 220 to 240°C and $BeBr_2 \cdot 2(C_2H_5)_2O$ starts at 70° and ends at 160 to 170°C. (R.V.J.)

21733 METHOD OF PRODUCING ORGANIC COMPOUNDS LABELED WITH RADIOCARBON (C^{14}). G. I. Levi, V. E. Vasserberg, and A. A. Balandin. Russian Patent 144,848. Jan. 13, 1961.

A method is suggested for the production of organic compounds labeled with radiocarbon (C^{14}) with oxygen-containing functional groups, or olefin-type groups. Radioactive C is introduced into the compound by means of a radical exchange with a standard labeled compound in the presence of a catalyst based on aluminum oxide within the boiling temperature range of 330 to 340°C of the labeled substance. (TCO)

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Refer also to abstracts 21435 and 22795.

21734 (ANL-6685) ALPHA-GAMMA ANGULAR CORRELATION MEASUREMENTS WITH LIQUID SOURCES. Elias Smith Murphy, Jr. (Argonne National Lab., Ill.). Feb. 1963. Contract W-31-109-eng-38. 64p.

Alpha-gamma angular correlation measurements were made with solid sources of Am^{243} and with liquid sources containing either Am^{243} or an even-even alpha emitter in dilute perchloric acid solutions. Even-even alpha emitters studied are U^{232}, Th^{230}, and Ra^{226}. Thicknesses of the solid sources were controlled so that the neptunium recoils from one source were stopped in Am_2O_3, while recoils from the other sources were stopped in the aluminum, gold, or mica backing on which the sources were vaporized. The liquid sources were films consisting of 3 microliters of solution placed between a rubber hydrochloride membrane and a microscope cover glass, 1 cm^2 in circular cross section. The perchloric acid concentration of the liquid sources ranged from 0.5 to 3.0 molar. All of the angular correlations obtained with solid Am^{243} sources were attenuated, the average attenuation coefficients being 0.29 ± 0.01 for sources in which recoils were stopped in Am_2O_3, 0.20 ± 0.01 for sources in which recoils were stopped in mica, 0.52 ± 0.02 for sources in which recoils were stopped in gold, and 0.67 ± 0.01 for sources in which recoils were stopped in aluminum. Unattenuated angular correlations were obtained with liquid sources containing Am^{243} in 0.5 M and 1.0 M $HClO_4$. For liquid sources containing Am^{243} in 3.0 M $HClO_4$, the correlation was attenuated, with an average attenuation coefficient of 0.86 ± 0.01. Attenuated angular correlations were also found with liquid sources containing an even-even nuclide in dilute aqueous solutions. The average attenuation coefficients for the even-even nuclide liquid sources were $G_2 = 0.75 \pm 0.05$ and $G_4 = 0.86 \pm 0.03$ for U^{232}, $G_2 = 0.64 \pm 0.06$ and $G_4 = 0.84 \pm 0.04$ for Th^{230}, and $G_2 = 0.76 \pm 0.11$ and $G_4 = 0.90 \pm 0.07$ for Ra^{226}. The postulate that the measured angular correlation function for Am^{243} is attenuated by the same amount as the correlation functions for the even-even nuclides is found to be untenable since it requires unreasonable alpha mixing ratios or unreasonable admixtures of M2 to E1 gamma radiation in the Am^{243} decay process. The attenuation observed with even-even nuclide sources is believed to be consistent with the postulate of a time-dependent electric interaction. 81 references. (auth)

21735 (RT/CHI(63)-4) SEPARATION OF CARRIER FREE LANTHANUM 140 FROM BARIUM 140. C. Cesarano and G. Pugnetti (Italy. Comitato Nazionale per l'Energie Nucleare, Rome). Jan. 1963. 23p.

A new method is described for obtaining a continual supply of carrier free La^{140} from its parent Ba^{140}, following the Brookhaven milking method for obtaining Y^{90} from Sr^{90}. The Ba^{140} is fixed on a cation exchange resin and La^{140} is milked with a 0.5% citric acid solution at pH 5.5. A purity better than 10^5 as the ratio of disintegrations of La^{140}/disintegrations of Ba^{140} is obtained. The distribution coefficients of La^{140} and Ba^{140} on the resin were determined as well as the yield of La^{140}. In addition a simple and rapid test for detecting the presence of Ba^{140} contamination in the La^{140} was also developed. (auth)

21736 (USNRDL-TR-632) A RAPID RADIOCHEMICAL PROCEDURE FOR TIN. A. E. Greendale and D. L. Love (Naval Radiological Defense Lab., San Francisco). Feb. 28, 1963. Contract AT(49-2)-1167. 14p.

A very rapid radiochemical procedure was developed for the isolation of radioisotopes of Sn from their fission-product isobars. An irradiated U solution containing Sn and Sb carriers is added to a solution of sodium borohydride. The volatile stannane (SnH_4) formed is decomposed in a hot quartz tube to the metal, which is collected on a cold surface. Stibine (SbH_3), which is also formed, is removed by absorption on an Ascarite column. The Sn chemical yield ranges between 15% for an Sb decontamination factor of 2×10^4 to 60% for an Sb decontamination factor of 10^3. The time required for separation of the Sn metal from the other fission product elements is about 10 sec. Decontamination factors of other Sn descendents are: $I = 7 \times 10^4$, and $Te > 2 \times 10^4$. Arsenic is also volatilized as the hydride; however, it is not necessary to eliminate it for the determination of the Sn fission yield. (auth)

21737 (AERE-Trans-929) RADIATION POLYMERIZATION OF FORMALDEHYDE. K. Hayashi, and H. Yamaoka. Translated by K. Hayakawa (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Genshiryoku Kogyo, 7: 31-8(1961). 24p.

An investigation was made of the low-temperature polymerization reaction mechanism of formaldehyde under the action of irradiation. It was found that a cationic mechanism occurs for bulk polymerization in methylene chloride and toluene solution, and an anionic mechanism in ethyl ether. (auth)

21738 (JPRS-18868) NEWS IN RADIATION POLYMERIZATION. I. M. Barkalov and V. I. Gol'danskii (Gol'danskiy). Translated from Khim. Prom., No. 12, 1-5 (1962). 19p. (OTS-63-21657)

A review on radioinduced polymerization is presented with special attention to solid polymerization. It was concluded that the prospects of using the orderliness of monomeric units in a crystal for the purpose of obtaining stereoregular polymers as well as the use of other specific characteristics of the reaction appear to be good. (P.C.H.)

21739 (KFK-tr-123) CHLORIERUNG VON ORGANISCHEN VERBINDUNGEN, INSBESONDERE VON BENZOLDERIVATEN, UNTER Co 60-GAMMASTRAHLUNG. (Chlorination of Organic Compounds, Particularly of Benzol Derivatives, under Co^{60} Gamma Rays). J. Imamura and N. Ota (Kernforschungszentrum, Karlsruhe, Germany). Translated into German from Tokyo Kogyo Shikensho Hokoku, 55: 295-304(1960). 30p.

The chlorination of benzol derivatives by the action of gamma rays from Co^{60} was investigated. At room temperature chlorination of benzol by gamma effects resulted chiefly in nuclear addition products. But for benzol derivatives with electron-yielding substituents the stronger the substitution chlorination of the benzol nucleus the greater the possibility is of the substituent yielding electrons. For electron-absorbing substituents the more difficult the chlorination the more marked the property of the substituent is for absorbing electrons. At high temperatures (80°C) side-chain chlorination was found to be more likely to occur. (M.C.G.)

21740 DEGRADATION PRODUCTS OF γ-IRRADIATED SOLID CARBOHYDRATES OBTAINED AFTER DISSOLUTION IN WATER. Anders Ehrenberg, Lars Ehrenberg, and Goeran Loefroth (Karolinska Inst., Stockholm and Stockholm Univ.). Acta Chem. Scand., 17: 53-6(1963). (In English)

It is shown by paper chromatographic analysis that a number of substances are formed when γ-irradiated solid carbohydrates are dissolved in water. CO_2 is formed from α-D-glucose with a G-value of 2.5, while D-fructose and sucrose gave no CO_2. The production of acidic groups of different carbohydrates showed a wide range of G-values, e.g., 1.0 for sucrose and 48 for lactose · H_2O. (auth)

21741 MASS SPECTROMETRIC STUDIES. VIII. A STUDY OF THE FRAGMENTATION OF NORMAL LONG-CHAIN METHYL ESTERS AND HYDROCARBONS UNDER ELECTRON IMPACT WITH THE AID OF DEUTERIUM-SUBSTITUTED COMPOUNDS. Nguyen Dinh-Nguyen, Ragnar Ryhage, Stina Staellberg-Stenhagen, and Einar Stenhagen (Univ. of Gothenburg, Sweden). Arkiv Kemi., 18: 393-9(1961).

Partially deuterated methyl esters and hexacosane were synthesized for the study of the fragmentation of normal long-chain compounds under electron impact. Mass spectra were determined with electrons of low energy, the main effect of the lowering of the electron energy to about 11 ev being that the hydrocarbon type peaks in the low mass range in the spectrum of a methyl ester disappear almost completely. Results obtained with various esters are discussed. The results showed that ions of the type $C_nH_{2n+1}^+$ obtained in the fragmentation of long-chain hydrocarbons under electron impact are formed by 2 different processes. (TCO)

21742 THE RADIOLYSIS OF HCl–HBr MIXTURES. R. C. Rumfeldt and D. A. Armstrong (Univ. of Alberta, Calgary). Can. J. Chem., 41: 1104-12(May 1963).

Bromine was the only halogen formed in irradiated mixtures of HCl and HBr. A study of its effect on the hydrogen yield from HCl showed that it reacted with the first hydrogen-forming species (or its precursor), and indicated the same yield for this species as did the earlier experiments with chlorine. The results were consistent with thermal hydrogen atoms, formed in the reaction $e^- + H-Cl \text{ --- } H-Cl \rightarrow H + Cl-H \text{ -- } Cl^-$, as the first hydrogen-forming species, and hot hydrogen atoms, resulting from the dissociation of excited HCl molecules, as the second species. The hydrogen yield from liquid HBr at −79°C was a factor of two larger than that from liquid HCl at the same temperature, and in mixtures of the two the hydrogen yield increased gradually from a value characteristic of pure HCl ($G_{H_2} = 6.5$) to one characteristic of pure HBr ($G_{H_2} = 12.4$). The smaller yield from HCl cannot be explained by radical combinations: $H + Cl + M \rightarrow HCl + M$ and $H + H + M \rightarrow H_2 + M$ in the radiation tracks and must be attributed either to differences in the ion-combination reactions in the two liquids or to a genuinely greater yield of ions and/or dissociative excited molecules in HBr. The hydrogen yield from solid HBr at −196°C was $G_{H_2} = 10.5$. (auth)

21743 INVESTIGATION OF THE ELECTRON-INDUCED DAMAGES IN MATERIALS USED IN ELECTRON MICROSCOPIC STUDIES. I. G. Stoyanova and T. P. Morozova. Dokl. Akad. Nauk SSSR, 148: 810-13(Feb. 1, 1963). (In Russian)

An attempt was made to correlate the structural damages observed in materials exposed to electrons during electron microscopic investigations with various experimental conditions. Low-pressure polyethylene single crystals were used for the study. A 15-micron diameter electron beam was used to irradiate the target. At first an electron microgram with bright interference maxima was obtained on the screen; after continued exposure which caused structural degradation of the material, the intensity and the

sharpness of the lines decreased, ultimately forming a washed-out halo. Variation of the experimental conditions indicated that the damage was more marked when a 2×10^{-4} mm of Hg pressure was used; less deterioration was observed when an inert gas was used under increased pressures. This was attributed to the formation of high electrostatic charges in the vacuum, these charges may reach 10^6 v/cm. Presence of air aggravated the damage because it interacted with the target material. (TTT)

21744 COMPARATIVE STUDY OF METHODS FOR CONTROLLING RADIOACTIVE PREPARATIONS. A. Heyndrickx (Inst. of Nuclear Studies, Oak Ridge, Tenn.). J. Pharm. Belg., 17: 267-92(Sept.-Oct. 1962).

Techniques employed in maintaining standards for radioisotope preparations for diagnostic and therapeutic use are described for P^{32}, Fe^{59}, Au^{198}, Y^{90}, S^{35}, Na^{22}, Na^{24}, K^{42}, I^{131}, I^{132}, Cr^{51}, and Co^{60}. (H.H.D.)

21745 UTILIZATION OF THE ORSAY ISOTOPE SEPARATOR FOR STUDY OF SPALLATION REACTIONS. N. Poffé, G. Albouy, and M. Gusakow. J. Phys. Radium, 23: Suppl. No. 12, 213A-15A(Dec. 1962). (In French)

A study was made of the (p,xn) reactions on Au, and a study is in process of these reactions on La. Separations were made of Hg and Ce. In the case of Au, irradiated in metallic form, the Hg is extracted by simple volatilization. The Ce, formed in La by (p,xn) reactions, is extracted chemically in the form of volatile $CeCl_3$. The isotope collection is generally made at the first stage of the separator, and the collector is a foil of Cu or Al. The second stage of the separator was used to study individually certain isotopes. The method used at the second stage to observe radioisotopes of very short period was described. At the first stage, the isotopes are collected simultaneously on the foil. The foil is then passed over a Pb collimator placed over a NaI(Tl) crystal. The detection apparatus is adjusted to an energy band corresponding to a characteristic radiation of the group of isotopes studied. The activities and the relative cross sections can be deduced from the spectrum intensity as a function of its position on the foil. Typical spectra obtained in this manner are shown. The technique is very rapid, and the quality of separation can be judged immediately. (J.S.R.)

21746 POLYMER FRACTIONATION STUDIES IN THE SOLID STATE POLYMERIZATION OF ACRYLAMIDE. B. Baysal, G. Adler, D. Ballatine, and A. Glines (Brookhaven National Lab., Upton, N. Y.). J. Polymer Sci., Pt. B, 1: 257-62(May 1963). (BNL-6367)

Fractionation studies were made on polymer from in-source (immediate isolation of polymer after irradiation) and post-irradiation (storage after irradiation) experiments on solid acrylamide. The results show a very broad molecular weight distribution in the in-source experiments and a large percentage of polymer of constant molecular weight in the post-irradiation experiments. Several possible explanations of the results are discussed. (D.L.C.)

21747 SOME CONTRIBUTIONS TO THE STUDY OF VINYL POLYMERIZATION IN THE CRYSTALLINE STATE. H. Morawetz (Polytechnic Inst. of Brooklyn, N. Y.). J. Polymer Sci., Pt. C, 1: 65-82(1963).

Results obtained with radiation-induced post-polymerizations of crystalline acrylamide and acrylic or methacrylic acid salts are reviewed. Some preliminary results with the spontaneous thermally initiated polymerization of crystalline p-acetamidostyrene and p-benzamidostyrene are presented. Observations of some organic reactions, other than polymerizations, which also seem to proceed in the crystalline state are described. The results obtained with solid-state polymerizations are discussed in terms of the nature of the propagating species, the interpretation of the kinetic pattern, and the role of the monomer crystal lattice. (auth)

21748 ON THE FORMATION OF CARBONYL COMPOUNDS FROM SATURATED FATTY ACIDS BY THE ACTION OF UV AND Co^{60} γ RADIATION. K. Taeufel and R. Zimmermann (Institut für Ernährung, Deutsche Akademie der Wissenschaften, Berlin). J. Prakt. Chem., 15: 127-38(1962).

A slight increase in peroxide number occurred during uv or γ irradiation of saturated fatty acids (propionic, butyric, valeric, caproic, enanthic, caprylic, pelargonic, capric, palmitic, and stearic acids). UV irradiation was carried out for 24 hr at 50°C and γ irradiation at dose of 1.5 Mrep at 20°C. In the secondary radiation reaction, which varied according to the dose, aldehydes, such as malondialdehyde, were formed. By the thiobarbituric acid reaction, significant formation of carbonyl compounds could be detected by γ irradiation of butyric acid with 38500 rep and palmitic acid with 28500 rep. Results of the color reaction paralleled the rise in peroxide number by the radiation-promoted auto-oxidation of the fatty acids. Irradiation in the presence of oxygen or water enhanced the oxidation and formation of carbonyl compounds. Conversely, the reactions were depressed in a nitrogen atmosphere, and the anti-oxidant α-tocopherol (but not α-tocopherol acetate) inhibited the reactions. It was estimated that γ irradiation of butyric acid in 5% aqueous solution at a dose of 4×10^4 rep promoted the formation of 0.018 mole carbonyl derivatives per kg (as propionaldehyde). The corresponding amount from uv irradiation (1.6×10^7 erg/ml) was 0.012 mole/kg. (H.H.D.)

21749 THE SEPARATION OF POLONIUM FROM IRRADIATED BISMUTH WITH ION EXCHANGERS. H. Koch and H. Schmidt (Institut für Angewandte Radioaktivitat, Leipzig). Kernenergie, 6: 39-42(Jan. 1963). (In German)

A method was described which permits the carrier-free separation of Po from irradiated Bi. The concentrated hydrochloric acid solution of the irradiation product was exposed to the exchanger Wofatit SbU or Amberlite XE 98. If concentrated HCl is used to elute the ion exchanger, no β or γ radiation can be detected. The Po remains on the exchanger. It can be dissolved with HNO_3 (1 : 1) or $HClO_4$ (1 : 1) from XE 98 or with concentrated $HClO_4$ from SbU. Approximately 17% remains on the SbU exchanger. The eluted Po solution is free of inactive Bi. (tr-auth)

21750 SYNTHESIS OF ALIPHATIC C^{14} LABELLED AMINES. G. Schleiser, H. Koch, and R. Buechner (Institut für Angewandte Radioaktivitat, Leipzig). Kernenergie, 6: 65-70(Feb. 1963). (In German)

The syntheses of β-oxy-n-nonylaminehydrochloride [-1-C^{14}], β-chlor-n-nonylaminehydrochloride [-1-C^{14}], β-brom-n-nonylaminehydrobromide [-1-C^{14}] are described and the critical micell concentrations specified, which were determined by conductivity measurements. Experiments for preparation of β-iod-n-nonylaminehydroiodide and amino-n-pelargonic acid nitrile hydrochloride did not lead to pure compounds. (tr-auth)

21751 SYNTHESIS OF PENTACHLORPHENOLE-$^{36}Cl_{(5)}$. M. Bubner and L. H. Schmidt (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 82(Feb. 1963). (In German)

Pentachlorphenol-Cl^{36} was prepared by chlorination of phenol and reduction of the originating hexachlorphenol-

Cl^{36}. The Cl_2^{36} was prepared from HCl^{36}. The yield was 68%. (M.C.G.)

21752 SYNTHESIS OF GLYCERINETRIPALMITATE-1-$^{14}C_{(3)}$. L. H. Schmidt and M. Bubner (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 82-3(Feb. 1963). (In German)

The esterification of palmitic acid-1-C^{14} with glycerine took place through the chloride. A yield of 65.4% was obtained. (M.C.G.)

21753 THE PREPARATION OF RADIOACTIVE HYDROXOCOBALAMIN. E. Lester Smith (Glaxo Research Ltd., Greenford, Middx, Eng.). Lancet, 1: 724-6(Apr. 7, 1962).

A method for the preparation of hydroxocobalamin from Co^{60}-labeled cyanocobalamin by photolysis in microgram amounts is described. As light sources, direct sunlight, north daylight, and tungsten-filament, or fluorescent lamps were used. After irradiation in aqueous solution, small columns of carboxymethyl (CM) cellulose (1 × 3 cm) were used to separate the neutral unabsorbed unchanged cyanocobalamin from the basic aquocobalamin (hydroxocobalamin), which is strongly retained. The column was eluted with dilute sodium chloride, and the solution was concentrated under reduced pressure. Photolysis was faster with acid solutions; a trace of acetic acid was therefore usually added to make the solution 0.002 N (pH about 4.5). It was then necessary to remove the acid on a small column of diethylaminoethyl cellulose before fractionation on CM cellulose. Conversion to hydroxocobalamin is slow even in bright light. At 1 μg (or less) per ml, conversion of over 95% of the cyanocobalamin can be ensured by exposure to direct (winter) sunshine for 4 hr, or to daylight on a dull day for 8 hr. (H.H.D.)

21754 MOLECULAR ENVIRONMENT EFFECTS IN THE RADIATION DECOMPOSITION OF α-D-GLUCOSE. G. O. Phillips and P. Baugh (University Coll., Cardiff, Wales). Nature, 198: 282-3(Apr. 20, 1963).

The chemical effects of γ radiation on anhydrous α-D-glucose were studied. It was found that the physical state in which the dry hexose is irradiated profoundly influences the course of the radiation decomposition. Data are presented on the effects of γ radiation on polycrystalline, syrup, and freeze-dried glucose. (C.H.)

21755 THE HYDRATED ELECTRON. Edwin J. Hart (Argonne National Lab., Ill.). News-Bull. Intern. (Argonne Natl. Lab.), 5: No. 2, 7-11(Apr. 1963).

Recent developments in radiation chemistry are reviewed with respect to the concept of the hydrated electron as a reducing species. Electron pulse spectral studies were carried out on deaerated water and solutions. The hydrated electron was found to have an absorption spectrum with a prominent peak in the region of 7000 Å and to have a lifetime on the order of 10^{-5} sec. The nature of the hydrated electron is discussed with reference to the 1953 predictions of Platzman on this species, and the reaction rate constants of this species in irradiated pure water are given. (D.L.C.)

21756 PREPARATION OF CARRIER-FREE ^{131}I WITH ADSORPTION METHOD. Chien-chang Lin, Chau-ting Chang, and Si Jung Yeh (National Tsing Hua Univ., Taiwan, China). Nippon Genshiryoku Gakkaishi, 5: 187-9(Mar. 1963). (In English)

A simple method for the preparation of carrier-free I^{131} is proposed, in which iodine is separated from the target material by extracting on a platinum surface. The radiochemical purity of the product was checked by means of half-life measurement and γ-ray spectrometry. Paper chromatographic determination indicated that most of the products were in iodide form. (auth)

21757 EFFICIENCY OF POLYTRIMETHYLSTYRENE TYPE FILM SCINTILLATORS. V. D. Bezuglyi, N. M. Grachev, and A. S. Dykhanov (All-State Research Inst. of Monocrystals, USSR). Pribory i Tekhn. Eksperim., No. 1, 163(Jan.-Feb. 1963). (In Russian)

The efficiency of poly-2,4,5-trimethylstyrene film scintillators used with a Po^{210} α source was about 50% higher than that of polystyrene film. A 2.5 diphenyloxazole (1% polymer weight) was added in the preparation of the scintillation film. (R.V.J.)

21758 ELECTRON SPIN RESONANCE SPECTRUM OF THE XeF RADICAL. W. E. Falconer and J. R. Morton (National Research Council, Ottawa). Proc. Chem. Soc., 95-6(Mar. 1963).

A single crystal of XeF_4 was irradiated at 77°K with 5 Mrad of Co^{60} γ rays, and its paramagnetic resonance spectrum was studied at 77°K. The spectrum is attributed to the species XeF and is consistent with the known isotopic distribution in xenon. The isotropy of the spectra implies that the Xe–F bond is probably parallel to the longitudinal axis of the crystal. Approximate hyperfine splittings for F^{19}, Xe^{129}, and Xe^{131} are 180, 425, and 125 G, respectively. (D.L.C.)

21759 RADIATION PROTECTION IN IRRADIATED DIMETHYLSILOXANE POLYMERS. A. Charlesby and P. G. Garratt (Royal Military Coll. of Science, Shrivenham, Wiltshire, Eng.). Proc. Roy. Soc. (London), Ser. A, 273: 117-32(Apr. 23, 1963).

Small concentrations of certain additives can greatly modify the effects produced by radiation of macromolecules such as polymers and biological systems. With anthracene in dimethylsiloxane polymers, however, no such dependence was observed. The additives studied were anthracene, iodine, sulfur, and benzophenone, and their protective effect on the crosslinking of dimethylsiloxane polymer was investigated at various dose rates. Contrary to generally accepted views on reaction mechanisms no dose-rate effect was observed; anthracene provided no protection against crosslinking, although it was itself destroyed. Iodine and colloidal sulfur provided a considerable measure of protection, but had no effect on gas evolution. Benzophenone also offered protection, but also reduced the gas yield. To explain these very different patterns of behavior, it is necessary to modify some present views on the nature of the protection offered; this leads to a discussion as to the mechanism of crosslinking. (auth)

21760 GAMMA RADIATION SOURCES FOR RADIOCHEMICAL APPARATUS. A. Kh. Breger. Radioaktiv. Izotopy i Yadernye Izlucheniya v Narod. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: 169-75(1961).

Nuclear radiation sources for effecting radiochemical processes on a semi-industrial scale were examined. Preference was given to the use of heat-producing elements and to the radiation loops of nuclear reactors. An evaluation of the efficiency of various conditions of utilizing heat-producing elements is presented. (Referativnyy zhurnal, Khimiya, No. 8, 1962).

21761 YIELDS OF Fe^{2+} ION OXIDATION IN H_2O ICE IRRADIATED WITH Co^{60} γ RAYS. Jerzy Kroh and John W. T. Spinks (Univ. of Saskatchewan, Can.). Roczniki Chem., 36: 563-4(1962).

Ice containing Fe^{2+} was irradiated at −196, −78, and −20°C with γ radiation at a dose rate of 4.8×10^{18} ev/ml/hr. After irradiation the samples were melted and the concen-

tration of Fe^{3+} ions determined by spectrophotometric examination. The $G(Fe^{3+})$ values in ice varied from 0.4 to 0.8 at −196, from 1.2 to 2.0 at −78°, and from 1.3 to 4.1 at −20°. The measurements were reproducible and showed a marked dependence of $G(Fe^{3+})$ on both pH and Fe^{2+} ion concentration. Some irradiations were carried out with pure ice; the samples of the latter, treated as a source of free radicals, were dissolved after irradiation in Fe^{2+} ion solution and the concentration of Fe^{3+} ions produced by the method was determined. (TCO)

21762 PHOTOLYSIS OF DEUTERIUM PEROXIDE AT LIQUID NITROGEN TEMPERATURE. Jerzy Kroh, Basil C. Green, and John W. T. Spinks (Univ. of Saskatchewan, Can.). Roczniki Chem., 36: 1337-40(1962).

Experiments were conducted on the uv photolysis of D_2O_2 at liquid nitrogen temperature. Ultraviolet irradiation of D_2O_2 resulted in phenomena very similar to those observed for H_2O_2. For D_2O_2 concentrations of the order of 10^{-1}M or higher the EPR spectrum indicated the presence of a DO_2 radical that was very similar to that for the HO_2 radical except for a smaller band width (by a factor of ~1.5) and complete lack of resolution. For lower concentrations, and particularly for longer irradiation periods, the pattern was gradually transformed into a triplet spectrum identical with the OD signal obtained by radiolysis of pure D_2O. It therefore seems that, as in the case of H_2O_2, OD radicals formed as primary products during photolysis are readily scavenged by D_2O_2, resulting in the formation of DO_2 radicals. The rates of HO_2 and DO_2 production are approximately the same. The radical concentrations ($\sim 1.5 \times 10^{18}$ spins/ml after 10^4 sec irradiation) reached much higher levels than the saturation concentrations of OH or OD radicals obtained by radiolysis of H_2O or D_2O at liquid nitrogen temperature. Other evidence for the formation of 2 different radicals (OD, DO_2) in the course of photolysis was provided by the thermal decay curves for the paramagnetic species present in the sample. The curves indicate the disappearance of the DO_2 radical, and the presence of the OD radical, not entirely scavenged by D_2O_2. (TCO)

21763 SELF-RADIATION PRODUCTS FORMED FROM 3,5,3′-TRIIODO-L-THYRONINE LABELED WITH I^{131}. A. van Zyl (Univ. of Cape Town, South Africa). S. African Med. J., 631-2(July 1961).

3,5,3′-Triiodo-L-thyronine-I^{131} was analyzed quantitatively for the formation of decomposition products at 2-week intervals, up to 75 days, by chromatographic, electrophoretic, and radioautographic means. The hormone had been labeled by exchange with I^{131} in the 3′-position only. The specific radioactivity varied from 21.4 to 29.6 mC/mg, and the concentrations from 13.0 to 19.5 μg triiodothyronine/ml in 50% propylene glycol. The 4 major radiochemical breakdown products formed were I^{131}, I^{131}-labeled 3,5-diiodothyronine, I^{131}-labeled thyroxine, and hydroxy-acid analog of triiodothyronine or of diiodothyronine, or both. It was established that the chromatographic solvents used were not responsible for breakdown products. The mechanism of the radiochemical decomposition of I^{131}-labeled triiodothyronine is outlined. It was concluded that the danger of interpreting a self-induced radiation product as a metabolic transformation exists. Furthermore, if a stored sample of I^{131}-labeled triiodothyronine is used for studies of red cell uptake, a correction factor is required. (TCO)

21764 THE PREPARATION OF RADIOACTIVE 7-DEHYDROCHOLESTEROL. B. D. Kulkarni, G. Blondin, and W. R. Nes (Clark Univ., Worcester, Mass. and Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Steroids, 1: 21-32(Jan. 1963).

The preparation of radioactive 7-dehydrocholesterol (5,7-cholestadien-3β-ol) by procedures that utilize milligram quantities of cholesterol as starting material is described. The isocaproate adaptation of the allylic bromination of cholesterol with N-bromosuccinimide followed by dehydrobromination was employed and found to be amenable to a scale of operation as small as 50 mg. Since this still represents a relatively large amount of radioactive cholesterol, the starting material was diluted with slightly more than 10 times its weight of nonradioactive cholesterol. The major by-product obtained by this method is 4,6-cholestadien-3β-ol, which can be removed by diluting the final reaction mixture by a factor of 1.3 with nonradioactive 7-dehydrocholesteryl isocaproate. This reduced the content of $\Delta^{4,6}$-steroid to the point where it was easily removed by several recrystallizations. Very pure 7-dehydrocholesteryl isocaproate was obtained in this way with a 16.6% recovery of the radioactivity of the starting cholesterol. The final specific activity was 8.12×10^5 cpm/mg when counted at ~20% efficiency. Hydrolysis yielded 7-dehydrocholesterol itself with a specific activity of 1.03×10^6 cpm/mg. (TCO)

21765 EFFECTS OF ADDITIVES ON THE FORMATION OF FREE RADICALS IN THE RADIOLYSIS OF PARAFFIN. N. Ya. Buben, A. T. Koritskii, and V. N. Shamshev. Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 1: 192-5(1961).

The importance of the electronic excitation energy transfer processes in the radiolysis of some solid organic substances and some singularities in the formation of free radicals in these substances are reported. In order to investigate the kinetics of alkyl free radical accumulation, a paraffin sample containing additive and having the shape of a small ball, 4 to 5 cm in dia, fitted on a thin thermocouple, was placed in the resonator of an electronic paramagnetic resonance device. The sample was then irradiated with a 1.6-Mev electron beam, and its temperature was regulated by a cold nitrogen jet. The free radical concentration was determined by comparison of the intensity of signals emitted by the sample with those emitted by a standard source containing a known number of paramagnetic particles ($CuCl_2 \cdot 2H_2O$). Small amounts of CCl_4 and hexachlorobenzene additives lowered the alkyl free radical concentration considerably. Such effects were not observed with heptene, octene, and nonyl alcohol additives. An explanation of the effects was attempted. (TCO)

21766 RADIOLYSIS OF PROTOPORPHYRIN SOLUTIONS. I. V. Vereshchinskii and P. Ya. Glazunov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 1: 324-8(1961).

Sufficiently stable protoporphyrin IX was irradiated with a fast electron beam and the spectra were recorded. The dose rate was determined by ferrosulfate dosimetry. The optical density of the solution dropped linearly to 10^9 ev/ml over a sufficiently wide range of integral doses. The radiochemical yield (0.1) of a benzene solution of protoporphyrin was about double that of an hexane solution. For sufficiently stable chloroform solutions of protoporphyrin IX, the sequence of absorption bands of protoporphyrin IX was replaced by that of absorption bands with maxima at 565 and 607 mμ. In addition, the solutions were dichroic. The absorption band intensity dropped noticeably with increasing duration of irradiation. No absorption bands pointing to the existence of bands with porphyrin nuclei appeared. As a result of irradiation, the molecules decomposed irreversibly to low-molecular products without characteristic absorption bands visible. (TCO)

21767 INVESTIGATION OF ROENTGENOLUMINESCENCE OF CRYSTALLOPHOSPHORS NaI(Tl). V. N. Vishnevskii, A. B. Lyskovich, N. S. Pidzyrailo, and Z. P. Chornii (L'vov State Univ., Ukrainian SSR). Ukr. Fiz. Zh., 7: 1101-5(Jan. 1963). (In Ukrainian)

The x-ray luminescence of NaI(Tl) was investigated. Crystal samples 2–3 mm thick and having a cross section area of 2 cm^2 were chipped off a large crystal in a dry chamber. Here they were placed in a frame between quartz glass and a beryllium plate. The samples were irradiated by means of an UPC-55 set-up with a cobalt anticathode. All investigations were conducted at room temperature. The character of the energy distribution in the x-ray luminescence spectrum was investigated. In the case of photoexcitation the spectrum consists of two bands: an intense one, well resolved, with a maximum at 420 mμ and a second, far less intense, with a maximum at about 330 mμ. On increasing the thallium in the crystal up to 2×10^{-4} (mol Tl/mol NaI) the area bounded by the intensity distribution curve in the luminescence spectrum increases proportionally to the activator concentration. On investigating the effect of x rays on the crystal, it was found that continuous, prolonged (up to 17 hours) irradiation of the crystal leads to a decrease in the intensity of luminescence. (auth)

21768 PHOTOLUMINESCENCE SPECTRA OF NaI(Tl) CRYSTALS. V. N. Vishnevskii, O. B. Liskovich, M. S. Pidzirailo, and A. M. Datsishin (L'vov State Univ., Ukrainian SSR). Ukr. Fiz. Zh., 7: 1127-8(Jan. 1963). (In Ukrainian)

Excitation spectra of Tl-activated NaI crystals at 10^{-6} (Tl mole/NaI mole) in crystals and 0.5, 1.0, 2.0, and 4.0 wt% Tl in solution were studied at room temperature. (R.V.J.)

21769 EFFECTS OF TEMPERATURE AND Tl CONCENTRATIONS ON ABSORPTION SPECTRA OF NaI CRYSTALS. O. B. Liskovich, V. I. Vaidanich, and N. K. Guseva (L'vov State Univ., Ukrainian SSR). Ukr. Fiz. Zh., 7: 1129-31(Jan. 1963). (In Ukrainian)

Absorption spectra of NaI crystals activated by Tl were studied at room and liquid nitrogen temperatures and Tl concentrations of $C \times 10^{-5}$ (Tl mole/NaI mole) (C = 0.1, 1.5, 11, 12, 20, 23, 25, and 45). (R.V.J.)

21770 WATER DECOMPOSITION BY FISSION FRAGMENT RECOIL ENERGY IN AN AQUEOUS SLURRY OF URANIUM–THORIUM OXIDES. Lawrence Russell Steele. Thesis, Columbus, Ohio, Ohio State Univ., 1962. 190p.

Measurements of the rate of decomposition of water as a function of particle size and concentration of a slurry of fissionable and fertile fuel were made. Irradiations of 10 cc samples of slurry, kept in suspension by a mechanical stirrer, were carried out in a nuclear reactor. By passing N through the slurry during the irradiation, the radiolytic gases were stripped from the slurry before they could recombine. The average particle size of the solid, which contained 10% natural U, was varied from 6 to 50 μ in diameter. Concentrations were between 300 and 1,000 g of solids per liter. To be able to correlate the experimental data, the fraction of fission recoil energy that had escaped to the water had to be known. This fraction could not be measured experimentally, whereas the total fission energy was measurable. Calculations of the energy distribution were thus made with the aid of a high-speed digital computer. The results indicate that the value of $G(H_2)$, the number of H molecules measured for every 100 ev of fission recoil energy absorbed by the water, is about 2.1. Although this value is higher than that previously reported for the yield in solutions of U, it is still in good agreement with expected values. This value also represents $G(-H_2O)$, the number of molecules of water decomposed by fission recoil energy in the water under steady-state conditions in a slurry reactor. (M.P.G.)

21771 TRITIUM MARKIERUNG: DARSTELLUNG, MESSUNG, UND ANWENDUNG NACH WILZBACH H^3-MARKIERTER VERBINDUNGEN IN MEDIZIN, CHEMIE, LANDWIRTSCHAFT, INDUSTRIE. (Tritium Labeling: Preparation, Measurement, and Application of Compounds Labeled by the Wilzbach Method in Medicine, Chemistry, Agriculture, Industry). M. Wenzel and P. E. Schulze. Berlin, Walter de Gruyter & Co., 1962. 176p. (DM-26)

The apparatus, procedures, and theoretical bases of the Wilzbach method are described, as well as its use in labeling various organic compounds. Measurement of specific activity of the products and their applications in numerous biological problems are discussed. (H.H.D.)

Raw Materials and Feed Materials

21772 (NLCO-873) HYDROMETALLURGICAL PROCESSING OF URANIUM-BEARING RESIDUE MATERIALS TO UF_4. J. H. Cavendish, H. M. Beers, and M. A. DeSesa (National Lead Co. of Ohio, Cincinnati). Nov. 1962. Revised Apr. 1963. Contract AT(30-1)-1156. 27p.

The processes used to recover U values from residues generated during the manufacture of fuel cores are described. The various low-grade residues, after suitable feed preparation, are treated in a hydrometallurgical process to recover the U values as uranyl ammonium phosphate (UAP). The UAP after calcination to uranium pyrophosphate is returned to the production stream as a U concentrate. High-grade residues, including uranium pyrophosphate, are converted by an aqueous precipitation process to hydrated UF_4, which is dehydrated and used for the production of U metal. (auth)

Separation Processes

21773 (DP-739) RECOVERY OF PLUTONIUM FROM IRRADIATED PLUTONIUM–ALUMINUM ALLOY. Carl S. Schlea, Myron R. Caverly, William J. Jenkins, Hugh E. Henry, and William C. Perkins (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1962. Contract AT(07-2)-1. 18p.

A chemical separations process was developed for the recovery of Pu from highly irradiated Pu–Al alloy. The irradiated alloy was dissolved in nitric acid with Hg^{2+} and F^- added as catalysts for the dissolution. Following clarification of the dissolver solution by precipitation of MnO_2, Pu in the solution was adjusted to Pu(IV) to provide a suitable feed for solvent extraction. Two cycles of solvent extraction with dilute tributyl phosphate gave adequate recovery of Pu and satisfactory separation from fission products. The process was operated successfully for large-scale recovery of Pu from irradiated alloy. (auth)

21774 (NP-12726) KONTROLLE DES QUALITATIVEN HALBMIKROTRENNUNGSGANGES HINSICHTLICH DES VERHALTENS DER SELTENEREN ELEMENTE UNTER ZUHILFENAHME VON RADIONUKLIDEN. (Control of Qualitative Semimicro Separations Processes with Regard to Behavior of Rare Earths Using Radioisotopes (thesis)). Klaus Riebartsch (Berlin. Technische Universitat). 1962. 95p.

The errors that can appear through nonquantitative precipitation, coprecipitation, etc., in qualitative semimicro separation methods according to Jander-Wendt, especially

with respect to the presence of rare earths, are discussed. At the same time indications are given which make is possible to avoid the uncertainty or to adjust the calculations. The behavior of compounds of Be, La, Ce, Mo, and W in separation processes were studied by tracer techniques. (M.C.G.)

21775 (ORNL-3381) EXPERIMENTAL BASIS FOR DESIGN OF MIXER SETTLERS FOR THE AMEX SOLVENT EXTRACTION PROCESS. A. D. Ryon and R. S. Lowrie (Oak Ridge National Lab., Tenn.). May 3, 1963. Contract W-7405-eng-26. 63p.

The basis for design of mixer-settlers for the Amex solvent extraction process, which uses long-chain amines dissolved in a hydrocarbon diluent for the recovery of U from acid sulfate solutions typical of those obtained in U ore processing, was determined by a unit-operations study in scale-model units. Long-term recycle tests in countercurrent equipment demonstrated the stability of amines and the general feasibility of the Amex process. Mass transfer rates of U for both extraction and stripping are large, and greater than 90% stage efficiency was readily obtained. The flow capacity of gravity settlers is generally limited by a dispersion band, which increases exponentially with flow rate. The scaleup of settlers is based on the constant flow rate of dispersed phase per unit settler area and constant band thickness. The nominal flow capacity (50% of flooding) ranged from 0.4 to 0.8 gpm/ft^2, depending on the type of dispersion and amine used. The capacity can be increased (fourfold) by using packing wetted by the dispersed phase. Emulsion stabilized by silica (the worst offender) can be minimized by controlling the mixing in order to form solvent-continuous dispersions, which also minimizes entrainment of solvent in the aqueous waste. (auth)

21776 (ORNL-TM-410) CHEMICAL TECHNOLOGY DIVISION. UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, SEPTEMBER 1962. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). May 1, 1963. Contract [W-7405-eng-26]. 42p.

Work is being initiated on the study of the coalescence of droplets in liquid-liquid systems in which the effect of ionizing radiation on film rupture will be investigated. A mathematical model was derived which correlates well with tests made on the oxidation of H_2 and CO in an He coolant stream such as is used in gas cooled reactors. The aqueous radiolysis products, H_2 and O_2, in radioactive solution carriers may be recombined by a hot wire Pt metal catalyst. The HETS for the separation of U from Th in 2-in.-dia. sieve plate pulsed columns using di-sec-butylphenylphosphonate in diethylbenzene was determined. (auth)

21777 (ORNL-TM-441) CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, NOVEMBER 1962. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). May 3, 1963. Contract W-7405-eng-26. 94p.

An acoustically shielded apparatus for studying the coalescence of drops in liquid-liquid systems was designed. Mass transport properties of H_2 and CO during reaction with high surface copper oxide were determined for the GCR Coolant Purification Program. The bench-scale leacher did not reproduce the behavior of the inclined rotary leacher in shear and leach studies. Four runs were made in the rotary leacher after modifications to prevent plugging of the inlet chute for the shear and leach program. Flooding rates and holdup data were obtained at A/O of 50 and 100 in a solvent extraction sieve plate pulsed column. The sol-gel process procedures, control, and analytical accuracy were demonstrated in cold engineering studies to be adequate for meeting BNL specifications. Batch kinetic solvent extraction studies using 30% Alamine 336 in DEB with Eu to simulate transuranium elements were conducted. High level waste processing run 69 using simulated TBP-25 waste and gravity feed is reported. (auth)

21778 (ORNL-TM-522) DESIGN STUDIES AND COST ESTIMATES OF TWO FLUORIDE VOLATILITY PLANTS. W. L. Carter, R. P. Milford, and W. G. Stockdale (Oak Ridge National Lab., Tenn.). Oct. 10, 1962. Contract [W-7405-eng-26]. 88p.

Design studies and cost estimates were made for two on-site, fluoride volatility processing plants. Each plant was assumed to be processing continuously irradiated $LiF-BeF_2-ThF_4-UF_4$ fuel from a one-region Molten Salt Converter Reactor (MSCR) capable of producing 1000 Mw(e) (ca. 2500 Mw(t)). One plant processed fuel at a rate of 1.2 ft^3/day, the second at 12 ft^3/day. The smaller plant was designed and cost estimated for two processing conditions: retention of the waste salt for Pa^{233} decay and recovery by a second fluorination, and discard of all Pa^{233} as waste after the first fluorination. The larger plant was considered only for the case of Pa^{233} decay and recovery. Capital and direct operating charges were estimated. The chemical processing scheme consisted of volatilizing uranium as UF_6 by treating the molten salt with elemental fluorine at about 550°C. The hexafluoride was then collected by absorption on NaF and condensation in cold traps, reduced to UF_4 in a H_2-F_2 flame, dissolved in make-up salt, and recycled to the reactor. Make-up fuel was supplied by purchasing fully enriched U^{235}. The Li, Be, and Th components of the fuel were discarded with fission product waste. (auth)

21779 AUTOMATIC ACTIVITY MEASUREMENTS DURING THE SEPARATION OF RADIOACTIVE COMPOUNDS BY THIN-LAYER CHROMATOGRAPHY. P. E. Schulze and M. Wenzel (Schering A. G., Berlin and Freie Universität, Berlin). Angew. Chem., Intern. Ed. Engl., 1: 580-2(Nov. 1962).

A method was developed for continuous automatic measurement of the radioactivity distribution of weak β emitters on open columns, such as thin-layer chromatograms. It may be used for analytical separations, as well as for preparative separations on a semimicro scale. During the measurements the substances are not contaminated by addition of other materials. For use with the method, a proportional gas-flow counter tube with an extremely flat aperture plate was developed. Since the aperture has no projecting parts, the chromatogram can be guided along on a carriage situated directly below the aperture slit. With this arrangement, soft β-ray emitters, including tritium, can be measured with high radiation yields. The distribution of the radioactivity is recorded via a cathode follower (connected to the counter tube) and a scaling unit with a synchronized recorder. Calibration curves for C^{14} and H^3 were prepared using thin-layer plates of silica gel. With the lowest activity measured, the error is for 0.0001 μC C^{14}, $\sigma_M = \pm 8\%$ and for 0.1 μC H^3, $\sigma_M = \pm 9.3\%$. For activities greater than 0.1 μC for H^3, and 0.001 μC for C^{14}, the error is less than $\pm 3\%$. With layer thickness of silica gel of 0.25 mm, the efficiency of measurement is ~40% for C^{14} and 0.3% for H^3. The separation of impurities from a nucleoside labeled with H^3 by thin-layer chromatography proved satisfactory, and 12 other applications of the method for preparative separation of labeled compounds are cited.

In combination with the present method of measurement, preparative thin-layer chromatography offers the possibility of combining easy measurement with sharp separations. (TCO)

21780 THE REPROCESSING PLANT AT KJELLER. K. P. Lindland (Institutt for Atomenergi (IFA), Kjeller, Norway). Atomwirtschaft, 8: 110-11(Feb. 1963). (In German)

A pilot plant for processing irradiated fuel elements, primarily from the JEEP reactor, was constructed at Kjeller. The plant contains facilities for mechanical decanning of the fuel elements, dissolution of the U, solvent extraction and separation, and concentration and storage of the various products. The Purex Process is used for the removal of fission products from the fuel and separation of U and Pu. The operation of the plant and the results obtained are discussed. (J.S.R.)

21781 SEPARATION OF CALCIUM AND RADIOACTIVE STRONTIUM BY PAPER CHROMATOGRAPHY. Pierre Lerch and Maurice Cosandey (Université, Lausanne, Switzerland). Chimia (Aarau), 16: 416-18(Dec. 15, 1962). (In French)

A radioautochromatographic method is described employing a solvent system consisting of 2-propanol containing 10% water and 10% NH_4CNS, in an atmosphere saturated with 2-propanol. As radioactive indicators, the pure β emitters Ca^{45} and Sr^{89} were used. The method of descending chromatography on Whatman No. 1 paper was also useful for the separation of Ba. Radioactivity of the strips was measured by a continuously recording scanner. The results showed a constant activity at various Sr concentrations using 20 μC Sr^{89}, but some absorption by Ca was noted of the softer radiation emitted by Ca^{45} under the conditions used. The R_f values for the pure isotopes were 0.60 for Ca^{45} and 0.15 for Sr^{89}, and 0.75, and 0.40 for concentrated solutions of Ca and Sr. The reproducibility of the method varied from 5 to 10%. Although precision below 5% was difficult to obtain, the method presented is simple and rapid. (H.H.D.)

21782 CHROMATOGRAPHIC SEPARATION OF RADIONUCLIDES WITH IRON(III)-HYDROXIDE ON PAPER COLUMNS. Hans-Heiko Stamm and Heinrich J. Schroeder (Kernforschungszentrum Karlsruhe, Ger.). J. Chromatog., 10: 392-5(Mar. 1963). (In German)

Iron(III) Hydroxide was absorbed on chromatography paper and separation of radioisotopes carried out by rising chromatography. In the anion experiments $(P^{32}O_4)^{3-}$, $(S^{35}O_4)^{2-}$, and $(Cl^{36})^-$ were separated from each other. In the cation experiments Sr^{90}, Y^{90}, Cs^{137}, and Ce^{144} were separated from one another. Good results were obtained. (M.C.G.)

21783 TRACER STUDIES ON THE EXTRACTION OF METAL IONS. 3. EXTRACTION OF IONS Mn(II), Fe(III), Co(II), Cu(II), AND Zn(II) BY MEANS OF 8-HYDROXYQUINOLINE-N-OXIDE. J. Mikulski (Inst. for Nuclear Physics, Krakow). Kernenergie, 6: 71-2(Feb. 1963). (In German)

The extraction processes of Mn(II), Fe(III), Co(II), Cu(II), and Zn(II) ions with 8-hydroxyquinoline-N-oxide and their dependence on the hydrogen concentration in the pH region 1 to 10 were investigated. The extraction medium was used in 0.1M chloroform solution. For Mn(II) ions the optimal extraction amounted to 60%, for Fe(III) and Co(II) ions about 75%, and for Cu(II) ions 90%. Zn(II) ions were not extracted. The experiments were carried out according to the indicator method with use of the radioisotopes Mn^{54}, Fe^{59}, Co^{60}, Cu^{64}, and Zn^{65}. (tr-auth)

21784 LABORATORY STUDY ON THE CHLORINATION REPROCESSING OF NEUTRON-IRRADIATED URANIUM FUELS. 2. DISTILLATIVE SEPARATION OF GASEOUS CHLORINATION PRODUCTS OF PILE-IRRADIATED URANIUM OXIDE. D. Naumann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 73-6(Feb. 1963). (In German)

The possibility of a separation of the gaseous chlorination products of reactor-irradiated uranium oxides by distillation at 600 to 700°C was investigated computationally and experimentally. The strongest deviation from ideal distillation behavior in the presence of the chief component UCl_4 was shown by plutonium chlorides. (tr-auth)

21785 ION EXCHANGE SEPARATION OF PLUTONIUM ON WOFATIT SBW IN ALCOHOLIC HYDROCHLORIC ACID. D. Naumann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 81(Feb. 1963). (In German)

The separation of Pu from U, Fe, and fission products in strong hydrochloric acid solution by ion exchange on the strongly basic polystyrol resin SBW was investigated. The solvent used was 2N HCl in 60% ethanol. Results are shown in graphs. (M.C.G.)

21786 PAPER ELECTROPHORESIS OF INORGANIC CATIONS IN THE PRESENCE OF COMPLEXING AGENTS. [PART] III. P. E. Wenger, W. von Janstein, and I. Kapetanidis (Universite, Geneva). Mikrochim. Ichnoanal. Acta, No. 1, 97-103(1963). (In French)

A study was made of the migration of the calcium, strontium, barium, and magnesium ions in the presence of β,β'-diaminodiethylether-N,N'-tetraacetic acid and as a function of pH. These ions showed an identical behavior, their separation was not possible under the conditions employed. The general possibilities of applying this method are summed up in a table. (auth)

21787 CONCERNING THE EXTRACTABILITY OF METAL COMPOUNDS OF DIPHENYLARSINIC ACID. R. Pietsch (Universität, Graz). Mikrochim. Ichnoanal. Acta, No. 1, 111-15(1963). (In German)

A report is given concerning the possibility of extracting metal ions from aqueous solution by means of organic liquids as compounds of diphenylarsinic acid. The ions investigated included Fe^{3+}, Al^{3+}, Bi^{3+}, UO_2^{2+}, Zn^{2+}, Cr^{3+}, Cd^{2+}, Cu^{2+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Be^{2+}, Pb^{2+}, Ca^{2+}, and Mg^{2+}. Of these only Pb^{2+}, Bi^{3+}, Be^{2+}, Zn^{2+}, and Al^{3+} are extractable with chloroform. With trichloroethylene only Pb^{2+} is extractable, whereas benzene and acetic ester show no extraction action. Comparisons were made with the behavior of aliphatic arsinic acids. (auth)

21788 SOLVENT EXTRACTION IN NUCLEAR CHEMICAL ENGINEERING. D. J. Morris (Manchester Univ., Eng.). Mutech Chem. Eng. J., No. 5, 31-8(1962).

Criteria for a separating method for the reprocessing of spent reactor fuels are outlined, and the reasons for the choice of solvent extraction are discussed briefly. A layout of a reprocessing plant is given, and the reprocessing steps used at Windscale are described. The limitations and problems of solvent extraction processes are considered. Equipment for the processes is discussed briefly. (D.L.C.)

21789 EXTRACTION OF METALS WITH STEARIC ACID INVOLVING RADIOACTIVE NUCLIDES. Taitiro Fujinaga, Mutsuo Koyama, and Shigeo Tsurubo (Kyoto Univ.). Nippon Kagaku Zasshi, 84: 128-30(1963). (In Japanese)

For the separation of metallic ions, stearic acid was introduced as a new extraction reagent. Solid low-melting point reagent such as stearic acid was expected to simplify

the procedure of solvent extraction of metallic elements especially of radioactive isotopes and to do the disposal of radioactivity in the wastes. The extraction can be carried out by adding a solid stearic acid to the sample solution heated above its melting point (71°C) and by separating the solid stearic acid after being vigorously shaken with the solution and being left standing to solidify at room temperature. The extractabilities of fission products such as Sr^{90}–Y^{90}, Ce^{144}–Pr^{144}, Ru^{106}–Rh^{106}, and also of nonactive ferric iron and cupric copper were investigated as functions of pH. It was concluded that the above elements except Ru were extracted almost completely from the solution at pH around 7. (auth)

21790 SOLVENT EXTRACTION OF BERYLLIUM, COPPER, NICKEL, COBALT AND ZINC AS DIBENZOYLMETHANE COMPLEXES. Tsunenobu Shigematsu, Masayuki Tabushi, and Tsunehiko Tarumoto (Kyoto Univ.). Nippon Kagaku Zasshi, 84: 131-4(1963). (In Japanese)

Besides the ferric chelate previously reported, dibenzoylmethane forms stable chelates as well with Be, Cu, Ni, Co, and Zn, which are extracted with chloroform or butyl acetate in appropriate pH region. Complete extraction can be attained at pH 5 to 10 for Be- and Cu-chelate, at pH 8 to 10 for Ni-chelate, at pH 9 to 10 for Zn-chelate, and near pH 10 for Co-chelate. Among these metals, Be alone is extracted in the presence of EDTA. The extraction method based on the extracting behavior thus revealed was applied to the following chemical separation process: Be from nuclear fission products; Fe from Cu, Ni, and Co; and Cu from Ni and Co. (auth)

21791 CATION-EXCHANGE SEPARATION OF SCANDIUM. Hiroshi Hamaguchi, Rokuro Kuroda, Korekazu Aoki, Ryuitiro Sugisita, and Naoki Onuma (Tokyo Kyoiku Univ.). Talanta, 10: 153-63(Feb. 1963). (In English)

A cation-exchange study of scandium is described. The distribution coefficients of scandium and other common metals were determined by a batch method. The empirical formula of the scandium complex existing in the thiocyanate-hydrochloric acid system is suggested as being $Sc(SCN)_2Cl$. Scandium can be separated from thorium, zirconium, iron, titanium, aluminum, and calcium using an ammonium thiocyanate-hydrochloric acid mixture as eluent. Some separation of scandium from the rare earths is also achieved, but the heavier rare earths cannot be separated cleanly. (auth)

21792 SEPARATING RARE-EARTH METALS BY FUSED SALT ELECTROLYSIS. L. E. Ivanovskii, N. G. Ilyushchenko, A. F. Plekhanov, and V. L. Zyazev. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural'sk. Filial, No. 2, 131-4(1961).

The separation of rare earth metals was investigated in fused bath electrolysis containing a mixture of rare earth chlorides. It was found that at all the D_c (0.25 to 1.5 amp/cm^2) and temperatures (850 to 870; 560 to 700°C) investigated, alloys were obtained that were considerably impoverished in La (3 to 5 wt %) and enriched with Ce (up to 80%). The total Pr and Nd amount remained practically constant. The nature of cathodic deposits varied noticeably with temperature. Their salt content varied from 75 to 80% at 560°C and from 30 to 40% at 700°C. (Referativnyy zhurnal, Metallurgiya, No. 8, 1962)

21793 CHROMATOGRAPHIC METHODS FOR Zr AND Be SEPARATION. T. A. Belyavskaya, I. P. Alimarin, and Ping-weng Mu. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 41-4(Sept.-Oct. 1962). (In Russian)

Zr and Be sorption by ion-exchange resins KU-2 and AV-17 from hydrochloric and nitric acids, ammonium carbonate and complexon(III) was studied for a wide range of acidity and complexing materials. A chromatographic method of separation was developed for Zr and Be separation using KU-2 and 2N hydrochloric or nitric acid for the quantitative ratio Zr : Be ~1 : 2000 to ~1 : 7000 and using KU-2 and 2% complexon(III) solution at Zr : Be from 25 : 1 to 1 : 800. (R.V.J.)

21794 STUDIES OF INDIUM BEHAVIOR IN SULFATE-ION SOLUTIONS BY MEANS OF ION EXCHANGE. E. P. Tsintsevich, S. G. Stancheva, and I. P. Alimarin. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 45-9(Sept.-Oct. 1962). (In Russian)

Distribution of indium between the KU-2, KU-1, and SBS cationites and $LiSO_4$, Na_2SO_4, K_2SO_4, $(NH_4)_2SO_4$, $MgSO_4$, and H_2SO_4 was studied. It is shown that a rise in sulfate ion concentration inhibits indium sorption. (R.V.J.)

21795 THERMODYNAMICS OF ION EXCHANGE ON SULFURIZED STYRENE AND DIVINYLBENZENE POLYMERS. G. L. Starobinets and V. S. Soldatov (Belorussian State Univ., USSR). Zh. Fiz. Khim., 37: 294-300(Feb. 1963). (In Russian)

Selectivity coefficients for the proton–cation exchange of Li^+, Na^+, K^+, Rb^+, and Cs^+ were measured on a cation exchanger with 6% divinylbenzene over the entire range of filling of the exchanger phase and at 0, 25, 60, and 90°C. The thermodynamic constants, free energy, enthalpy and entropy of the exchange, were calculated and the activity coefficients also calculated. There is a linear relation between the enthalpy and bound energy for all the systems studied. The nature of the near hydration exerts a marked influence on the entropy and a very large influence on the selectivity of the exchange. In the region of low filling of the exchanger phase, ions with negative near hydration (K^+, Rb^+, Cs^+) are characterized by lower activity coefficients and much greater selectivity coefficients than the positively hydrated ions (Li^+, Na^+). This bears evidence of particularly strong interaction of negatively hydrated cations with the fixed exchanger groups, leading in all probability to the formation of ion pairs. (P.C.H.)

21796 REACTOR FUEL PROCESSING. Volume 6, No. 2. Stephen Lawroski, ed. (Argonne National Lab., Ill.). Apr. 1963. 75p. $0.55(GPO) (domestic), $0.70(GPO) (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC).

A review of reactor fuel processing is presented. Topics covered include: commercial aspects of fuel processing; research and development on aqueous processing; research and development on nonaqueous processing; waste disposal; and production of uranium, thorium, plutonium, and their compounds. Separate abstracts were prepared for each topic. (M.C.G.)

21797 COMMERCIAL ASPECTS OF FUEL PROCESSING. p.1-4 of "Reactor Fuel Processing. Vol. 6, No. 2."

Fuel-processing plans and fuel-cycle economics are discussed. Facilities being developed for fuel processing are described. Analyses of the Pu–U and Th–U fuel cycles are presented. (M.C.G.)

21798 RESEARCH AND DEVELOPMENT ON AQUEOUS PROCESSING. p.5-20 of "Reactor Fuel Processing. Vol. 6, No. 2."

Chemical removal of cladding materials, dissolution of fuel cores, total dissolution of metallic fuels, and treatment of graphite and carbide fuels in preparation of fuel for process are described. Solvent-extraction process is discussed. Plant and equipment design and operation are

covered. Corrosion of construction materials in fuel processing systems is also discussed. (M.C.G.)

21799 RESEARCH AND DEVELOPMENT ON NON-AQUEOUS PROCESSING. p.21-40 of "Reactor Fuel Processing. Vol. 6, No. 2."

Liquid-phase, fused-salt, dry-halogenation, and direct-fluorination volatility processes are discussed. Pyrometallurgical processes described include melt refining and liquid-metal and salt methods. Oxide and carbide fuel processing is also discussed. (M.C.G.)

21800 WASTE DISPOSAL. p.41-61 of "Reactor Fuel Processing. Vol. 6, No. 2."

Treatment of liquid wastes by ion exchange and foam separation is discussed. Conversion of high-level wastes to solids by spray calcination, fluid-bed calcination, and pot calcination is described. Disposal to permeable formations, disposal by hydraulic fracturing into shale, calcined solids storage in salt mines, direct liquid disposal in crushed salt, and sea burial are also discussed. Processes for extraction of fission products from wastes are described. Corrosion in waste processing is also considered. (M.C.G.)

21801 PRODUCTION OF URANIUM, THORIUM, PLUTONIUM, AND THEIR COMPOUNDS. p.62-72 of "Reactor Fuel Processing. Vol. 6, No. 2."

The preparation of UO_3 by continuous calcination of uranyl nitrate is described and its properties are discussed. The preparation of UO_2 both by conversion of UF_6 to UO_2 and the reduction of UO_3 with ammonia is covered. Characteristics of UO_2 are discussed. The methods of preparing uranium borides, carbides, and nitrides and plutonium-containing ceramics are also described. The production of uranium metal powder is also considered. Methods of preparing ThO_2 and Th metal are discussed. (M.C.G.)

21802 IMPROVEMENTS IN OR RELATING TO TREATMENT OF URANIUM HEXAFLUORIDE. Trevor James Brown, Norman Thomas Harper, and Harold Woodward (to United Kingdom Atomic Energy Authority). British Patent 924,410. Apr. 24, 1963. Filed Sept. 8, 1954.

A method is given for removing UF_6 from gaseous effluent, such as from gaseous diffusion plants. The method comprises passing the gas through a bed of granular anhydrous Na_2CO_3 which is maintained at 150 to 200°C. The Na_2CO_3 particles should be of such a size that they pass through a sieve of 22 meshes/inch and are retained by a sieve of 100 meshes/inch. (D.L.C.)

21803 METHOD FOR REDUCING TETRAVALENT PLUTONIUM TO TERVALENT PLUTONIUM, ESPECIALLY IN CONNECTION WITH A SEPARATION OF PLUTONIUM FROM URANIUM. R. Wagner (to Commissariat à l'Énergie Atomique). German Patent DAS 1,144,249. Feb. 28, 1963. Priority date, Dec. 23, 1958, France.

The method described is for the reduction of tetravalent plutonium to tervalent plutonium and it enables the simultaneous separation of plutonium and uranium. The reduction is effected by ascorbic acid in the presence of a nitric acid agent. If a water solution of a nitric acid is added to a solution consisting of an organic solvent and Pu(IV), in which eventually a certain amount of uranyl nitrate is dissolved, the Pu(IV) is reduced by the ascorbic to Pu(III), the latter being transposed into the watery solution. (Gmelin Inst.)

21804 DISSOLUTION OF URANIUM FUELS BY MONO- OR DIFLUOROPHOSPHORIC ACID. R. Johnson, F. L. Horn, and G. Strickland (to U. S. Atomic Energy Commission). U. S. Patent 3,088,800. May 7, 1963.

A method of dissolving and separating uranium from a uranium matrix fuel element by dissolving the uranium-containing matrix in monofluorophosphoric acid and/or difluorophosphoric acid at temperatures ranging from 150 to 275°C, thereafter neutralizing the solution to precipitate uranium solids, and converting the solids to uranium hexafluoride by treatment with a halogen trifluoride is presented. (AEC)

21805 SELECTIVE SEPARATION OF URANIUM FROM FERRITIC STAINLESS STEELS. R. J. Beaver and J. H. Cherubini (to U. S. Atomic Energy Commission). U. S. Patent 3,089,751. May 14, 1963.

A process is described for separating uranium from a nuclear fuel element comprising a uranium-containing core and a ferritic stainless steel clad by heating said element in a non-carburizing atmosphere at a temperature in the range 850-1050°C, rapidly cooling the heated element through the temperature range 815° to 650°C to avoid annealing said steel, and then contacting the cooled element with an aqueous solution of nitric acid to selectively dissolve the uranium. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstract 22090.

21806 (DP-820) AUTOMATIC CRANE CUTOFF DEVICE. Whitfield F. Woodhead (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1963. Contract AT(07-2)-1. 13p.

An overload safety device was designed to prevent the cable of a traveling crane from breaking when the load is snagged. When an overload occurs, a spring-mounted pulley deflects and actuates limit switches to shut off the crane and hoist motors. To accommodate inertial motion of the crane, the pulley will deflect about 8 inches before the load limit of the cable is reached. (auth)

21807 (LADC-5775) A RE-CIRCULATING WET VACUUM CLEANING AND SCRUBBING SYSTEM FOR DECONTAMINATION. P. J. Peterson, D. C. Carlson, and R. W. Walker (Los Alamos Scientific Lab., N. Mex.). [1960]. Contract W-7405-eng-36. 5p.

A recirculating wet vacuum cleaning and scrubbing system was devised for decontamination of the interior of alpha sealed boxes. The system utilizes a pump capable of handling both air and water to recirculate the decontamination solution. The solution (plus box air) is pumped to the reservoir under a pressure of ~12 lb/in.^{2} and at a rate of ~1.5 l/min. The reservoir is a standard alpha-transfer can separated into two sections, the lower part serving as the solution reservoir and the upper section providing space for storage of the hose leading the vacuum pickup head. This permits remote introduction and removal of the system while maintaining an alpha tight seal on the box. Main advantages of the system are listed and a diagram is given. (P.C.H.)

21808 (TID-18566) HOT METALLOGRAPHY FACILITY AT SAVANNAH RIVER LABORATORY. R. D. Kelsch (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Apr. 1963]. Contract AT(07-2)-1. 10p.

The remote Metallography Facility at Savannah River is described. The facility is installed in 5 general-purpose hot cells, each 6 × 6 ft in floor area. Each cell is equipped with a pair of Model 8 master-slave manipulators. A large degree of flexibility was achieved by designing the equipment on a modular basis. The mounting press, grinder, polishers, and etchers all fit in the same size mounting space in the table and can be rearranged as needed. The arrangement of major equipment is also described. (P.C.H.)

21809 (UCRL-7291) SHOCK SPECTRA FOR A GENERAL FORCING FUNCTION. A. F. Todaro (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 25, 1963. Contract W-7405-eng-48. 13p.

Shock spectra, which are the maximum responses of many one-degree-of-freedom systems to a particular shock force or motion, can be helpful in the understanding of the general motion of elastic bodies subjected to shock forces or motions. While shock spectra for well-defined analytic functions are available, those for nonanalytic forcing functions are not so easily found. A method for determining these spectra is described. The mathematical development, computer derivation, and uses of shock spectra are discussed. (auth)

21810 (Y-1413) THE DESIGN AND PERFORMANCE OF LEVITATION MELTING COILS. W. J. Hulsey (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Mar. 5, 1963. Contract W-7405-eng-26. 70p.

A study was undertaken to evaluate the parameters involved in the performance of levitation coils with particular emphasis on the heating effect. The field strength along the axes of various coils was measured using a small search coil, the voltage induced on this search coil being proportional to the field strength. The search coil was calibrated with a straight solenoid coil in which the field strength was calculated. By considering each turn of a levitation coil as a short solenoid whose length was the tubing diameter, the field strength contribution from each turn was calculated. These values were summed along the axis to calculate the coil field. To aid these calculations, tables of field strength as a function of axial distance were prepared for various radii turns to different sizes of tubing. The rate of increase of field strength along the coil axis per ampere of coil current was defined as the coil gradient. A parametric equation was derived relating the power input to a levitated sample to the coil gradient, sample size and resistivity, and frequency. The validity of this equation was checked by measuring the power input to levitated samples of various metals. The samples were coated with a temperature sensitive paint and heated at a constant power input. The power was calculated using the heat capacity and time to reach temperature. The contribution from a given turn to the total coil gradient was calculated as a function of its location. These data were graphed with axial distance as abscissa and turn radius as ordinate showing positions which give the same values of gradient contribution. The positions which contribute most to the coil gradient could be used to design coils of high gradient and, consequently, good heating efficiency. Other results of the study include a possible method for measuring the surface tension of molten metals and a method for choosing the minimum frequency for efficient heating of a levitated sample. (auth)

21811 (TRG-Inf-Ser-287) THE SUPPORT OF FAST-ROTATING HIGH-POWERED GEAR UNITS. W. Froessel. Translated by H. W. Curtis (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Maschinenmarkt, 63: No. 22, 1-4(1957). 9p.

Bearing problems met in applications where high power is transmitted with an increase of revolutions are discussed. Design and lubrication are considered, and fundamentals of the calculations are given. Disadvantages of cylindrical sleeve bearings are noted. (D.C.W.)

21812 THERMAL STRESSES AND DEFORMATIONS IN A LONG BAR WITH NONUNIFORM, INTERNAL HEAT RELEASE. V. A. Tsykanov. At. Energ. (USSR), 14: 322-4(Mar. 1963). (In Russian)

The high specific power of reactors generates a considerable amount of heat in the various structural elements resulting in deformations and stresses in the system. Nonuniform heat-releasing sources are formed in structural elements placed near the core by the absorption of γ quanta. The distribution of these sources may be calculated by a one-dimensional function. Stresses and deformations were calculated in bars with rectangular cross section because such elements may be used for fabricating control rods or reflectors. The problem was limited to steady-state con-

ditions, thermoelastic stresses, and deformations; it was further assumed that the heat-releasing sources do not change with the location according to the height and that the heat transfer constant is temperature-independent. The formulas derived may be used for practical computation in a simplified form. (TTT)

21813 PEACEFUL USES FOR NUCLEAR EXPLOSIVES. Leonard Bertin. Can. Nucl. Tech., 2: No. 2, 30-2(1963).

A discussion is presented of possible applications of nuclear explosions and of various developments in the Plowshare program. Both contained explosions (Gnome) and cratering experiments (Sedan) are discussed. The possible use of explosions in utilizing oil reserves is considered in some detail, and Project Oilsand is described briefly. (D.L.C.)

21814 A FLUID-FREE, STAINLESS STEEL, ULTRA-HIGH VACUUM SYSTEM FOR SURFACE PHYSICS MEASUREMENTS. J. -C. Rivière (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Vide, 18: 18-25(Jan.-Feb. 1963). (In English and French)

Ultra-high vacua down to and below 10^{-10} torr may be achieved quickly and conveniently without the use of diffusion or rotary pumps. A good substitute for a rotary pump is a VacSorb sorption unit, which will roughen the system down to 20μ. In place of diffusion pumps, the Penning-type VacIon pump is most suitable for producing a vapor-free vacuum. Two 40 l/sec VacIon pumps, operating on a reciprocal baking-pumping routine, with a baking temperature of 465°C, can achieve a pressure of about 5×10^{-11} torr in a system 60 hours after the initial refrigeration of the VacSorb. The system can be maintained at this pressure as long as desired, without requiring any further treatment. The residual gas is almost certainly water vapor. (auth)

21815 A STUDY OF INERT GAS CLEANUP IN THE HOT-CATHODE IONIZATION GAUGE. F. A. Baker (Standard Telephone Cables Ltd., Footscray, Kent, Eng.) and J. Yarwood. Vide, 18: 26-34(Jan.-Feb. 1963). (In English and French)

The cleanup characteristics of modified Bayard-Alpert pattern gages were studied in krypton, argon, and helium. Two gages were examined; in the first the electrode structure was screened from the glass envelope by means of a molybdenum cylinder, while in the second the inner surface of the glass envelope was platinized. It was found that marked differences arise in cleanup and recovery of the different gases used in the investigation. Krypton was least readily pumped and helium the most. Cleanup was found to be more efficient when using the molybdenum screen as opposed to the platinized envelope. However, the initial speed of pumping argon was found to be greater than that for helium when using the molybdenum screen. Spontaneous recovery of previously pumped gas was observed for both gages after pumping krypton and argon but did not appear to rise when using helium. The rate at which gas was spontaneously recovered indicated a surface removal mechanism but application of the Frenkel equation provided evidence to the contrary. This anomaly was considered and it was found necessary to explain cleanup in terms of positive ion penetration of the solid surfaces on which they impinge. (auth)

21816 VACUUM DESORPTION. A. Schram (Centre d'Études Nucléaires, Saclay, France). Vide, 18: 55-68 (Jan.-Feb. 1963). (In English and French)

A general survey is given of the present knowledge in this field. Important discrepancies between the experimental results and the theoretical explanations put forward by the different authors are pointed out. The complexity of the phenomenon is emphasized and the relative importance of the different elementary processes are discussed. A limited choice of research is proposed for desorption in vacuum. Theoretical calculations based on simplified models are compared with some experimental results. The knowledge of the true surface area was found to be necessary and an experimental method used to measure this surface is described. The experimental curves of desorption are discussed taking in account the first results of true surface area measurements. In unbaked systems the absorbed gas layers at the surface were found to yield the most important part of the total desorption rate. The residual desorption of baked systems in ultra-high vacuum techniques seemed more likely to be a bulk (diffusion, permeation), rather than a surface phenomenon. Analysis by such mass spectrometers as the omegatron became a necessity. (auth)

21817 POSSIBILITY OF USING HELIUM CONDENSATION PUMP FOR PUMPING MAGNETIC TRAPS. E. S. Borovik, F. I. Busol, and V. A. Kovalenko (Khar'kov Inst. of Physics and Tech.). Zh. Tekhn, Fiz., 33: 100-4(Jan. 1963). (In Russian)

The maximum thermal load for helium cooled (3°K) surfaces was determined, and conditions for preventing helium condensation from emitting too much plasma heat and for retaining a high pumping rate were found. It is shown that nitrogen or water shutters protect helium condensation pumps, and that even double protection does not inhibit the high pumping rate. The tabulated data show that the rate of nitrogen pumping is 1.25 l/sec (hydrogen 4.68 l/sec) per cm^2 of internal water shutter surface. The prospects for using helium condensation pumps with continuous fluid flow and simultaneous helium vapor pumping seem to be favorable. (R.V.J.)

21818 ELECTRIC PROPULSION DEVELOPMENT. Ernst Stuhlinger, ed. A Selection of Technical Papers Based Mainly on the American Rocket Society Electric Propulsion Conference held at Berkeley, California, March 14-16, 1962. New York, Academic Press Inc., 1963. 861p. $10.50.

A cross section of the problems of electric propulsion that presently occupy the front line of interest and effort is presented. The papers are grouped in four chapters: Electrothermal or Arc Jet Propulsion; Electrostatic or Ion Propulsion; Electromagnetic or Plasma Propulsion; and Space Testing and Space Missions. Separate abstracts were prepared for thirty-two of the thirty-five papers presented. The other three were previously abstracted in NSA (16: 26628, 32477, and 32611). (C.E.S.)

21819 OBJECTIVES AND DESIGN OF A 1-KW ARC-JET ENGINE FOR SPACE FLIGHT TESTING. Russell J. Page and Harold Humpal (Plasmadyne Corp., Santa Ana, Calif.). p.3-20 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

An analytical and experimental program of the objectives of flight testing and the design considerations of a 1-kw plasmajet flight test engine ultimately suitable for attitude/orbit control of spacecraft in the 1965 period is covered. The relation of the flight test engine design philosophy to the final attitude/orbit control system is discussed. The choices of propellant, storage, feed system, electric power adaptation, and starting system are treated. Hydrogen and ammonia propellants are compared as a function of mission time using the current advanced technology. The benefits of supercritical hydrogen storage in the small sizes and the general lack of zero gravity feed problems are dis-

cussed. The flight test engine storage and feed system is described. Recent advances in efficient power adaptation, by Plasmadyne and Marshall Space Flight Center, of an arc to power source using constant current controls are reported. A new, simple technique for making, experimentally, over 7000 consecutive successful starts without noticeable erosion is described. (auth)

21820 DEVELOPMENT WORK ON PLASMA ARC JET ENGINES. Robert Richter (General Electric Co., Evendale, Ohio). p.21-42 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Problems associated with arc jet engines were attacked analytically and experimentally. Both phases are described. Analytically predicted performances and actual test results are compared. The analytical work includes: thermodynamics of the open cycle; nozzle fluid dynamics; and heat transfer. From the thermodynamic analysis, operating requirements can be determined for an ideal plasma arc jet engine for which minimum performance was specified. The fluid dynamic analysis and heat transfer analyses evaluate losses peculiar to a particular engine design. The fluid dynamic analysis points to substantial profile losses in the divergent section of the nozzle. It is shown that adjustment of the nozzle profile (which is based on an ideal flow) can minimize underexpansion losses. The heat transfer analysis evaluates temperature distribution in the engine and determines heat losses for various engine designs: radiation cooled and regenerative convection-radiation cooled. Test facilities and instrumentation are described briefly. Accuracy of measured test data is discussed and instrumentation limitations are objectively evaluated. (auth)

21821 ARC JET ENGINE PERFORMANCE–EXPERIMENT AND THEORY IV. R. R. John, M. M. Chen, J. F. Connors, and J. F. Megrue (Avco Corp., Wilmington, Mass.). p.43-68 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A status of a continuing effort on the analytical and experimental determination of arc jet engine performance is presented. Experimental results are presented on the behavior of arc engine voltage, current, thrust, and chamber pressure following the initial power input. The time to reach steady-state operating conditions is shown to be of the order of 5 min. Results are presented on the engine thrust and specific impulse following power shutoff. The time required for engine cooling is of the order of 1 hr. A model is presented for the nozzle flow pattern in an arc jet engine with spatially nonuniform flow. Preliminary discussions are presented on the performance of a combined arc engine crossed-field accelerator. (auth)

21822 ARC JET DESIGN. Paul S. Masser (Masser Engineering Co., Santa Ana, Calif.). p.69-77 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

An analysis of the flow conditions through the cylindrical front electrode of a typical arc jet with radial symmetry is presented. This analysis combines the momentum, energy, and continuity equations with Ohm's law and continuity of current to provide a series of equations that can be solved directly on a digital computer. The analysis is compatible with reasonable methods of representing the gasdynamic properties. Electrical conductivity can be a function of both the equation of state of the gas and the voltage gradient. A computer solution using simplified gasdynamic properties is presented for the case of 0.01 lb/sec of hydrogen, 1-atm pressure, and 1000-amp current. It is seen that the results are reasonable and the solution is stable. The accuracy is limited chiefly by the gasdynamic properties used. (auth)

21823 MATERIALS PROBLEMS RELATED TO THE ELECTRIC ARC JETS. Quentin H. McKenna and Dan W. Gates (Plasmadyne Corp., Santa Ana, Calif. and National Aeronautics and Space Administration, Huntsville, Ala.). p.79-93 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

The criteria on which the selection of materials for an electric arc jet engine is based are given. Potentially useful materials that might serve as electrodes, electrical insulators, and assembly housings are listed based on their properties, availability, and fabricability. (auth)

21824 A CHEMICAL ARC-JET ROCKET FEASIBILITY STUDY. R. W. Bender (Martin-Marietta Corp., Denver). p.95-120 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Chemically reactive propellants in the arc-jet rocket engine were studied to select a propellant for vehicle performance rather than for specific impulse or energy conversion efficiency. The criterion used was ability to impart a maximum velocity increment to the vehicle for given values of specific powerplant weight, payload fraction, and vehicle acceleration. Thermochemical and propellant tankage investigations were conducted. A digital computer was used to investigate the monopropellants hydrazine, hydrogen peroxide, and Cavea B; and the bipropellant combinations nitrogen tetraoxide/hydrazine, liquid oxygen/liquid hydrogen, and hydrogen peroxide/pentaborane. Dissociation and ionization effects were studied to temperatures of 18,000°R. Pressures were varied over several orders of magnitude. Both shifting and frozen equilibrium calculations were performed. Structural fractions were found to be of primary significance. It was concluded that a propellant of high density and low vapor pressure, such as hydrazine, is superior to hydrogen and ammonia. (auth)

21825 CHEMICAL NONEQUILIBRIUM EFFECTS IN THERMAL ARC JET PROPULSION. A. Mironer and H. Macomber (AVCO Corp., Wilmington, Mass.). p.121-46 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

An approximate method for determining the freezing point in an expanding plasma flow is presented. The analysis further shows that the flow is completely frozen in the dissociation recombination reaction for nozzle throat diameters of less than 10 cm and throat pressures of about 1 atm. The engine performance for both equilibrium and frozen flow is evaluated in terms of the frozen flow and nozzle expansion efficiencies. (auth)

21826 MAGNETICALLY DIFFUSED RADIAL ELECTRIC-ARC AIR HEATER EMPLOYING WATER-COOLED COPPER ELECTRODES. Robert F. Mayo and Don D. Davis, Jr. (National Aeronautics and Space Administration, Hampton, Va.). p.147-62 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A magnetically rotated electric-arc air heater was developed that is novel in that an intense magnetic field of the order of 10,000 to 25,000 gauss is employed. This field is supplied by a coil that is connected in series with the arc. Experimentation with this heater has shown that the presence of an intense magnetic field transverse to the arc results in diffusion of the arc and that the arc has a positive effective resistance. With the field coil in series with the arc, highly stable arc operation is obtained from a bat-

tery power supply. External ballast is not required to stabilize the arc when it is operating at maximum power level. The electrode erosion rate is so low that the airstream contamination is no more than 0.05% and may be substantially less. (auth)

21827 FIELD EMISSION MICROSCOPE STUDY OF THE KINETICS OF CESIUM LAYERS ON A TUNGSTEN SURFACE. L. W. Swanson, R. W. Strayer, F. M. Charbonnier, and E. C. Cooper (Linfield Research Inst., McMinnville, Ore.). p.165-93 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Surface diffusion and thermal desorption of cesium coatings on a tungsten substrate were investigated by field emission microscopy. Measured values of the surface diffusion activation energy range from 8 kcal/mole to 18 kcal/mole, depending upon the degree of coverage and the crystallographic orientation of the substrate, for coverages less than a monolayer. The heats of desorption measured for neutral atoms vary from 18 kcal/mole at 1 monolayer of cesium coverage to 69 kcal/mole at 0 coverage. An average heat of ionic desorption of 55 kcal/mole is obtained for the range of coverage from 0 to 0.07 monolayer. Further detailed information obtained from the field emission patterns is described. The present data are compared with published data, showing good agreement over part of the range of coverages investigated; regions where departures occur are discussed, and interpretations of the discrepancies are presented. (auth)

21828 EXPERIMENTAL EVALUATION OF POROUS MATERIALS FOR SURFACE IONIZATION OF CESIUM AND POTASSIUM. O. K. Husmann (Hughes Research Labs., Malibu, Calif.). p.195-217 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Experimental evaluation of porous tungsten and rhenium pellets at total pressure below 10^{-7} mm Hg and with current densities between 0.1 and 10 ma/cm^2 or more resulted in ionization efficiencies between 90 and 99% for tungsten with cesium. In the same total pressure range, the ionization efficiency of rhenium is more dependent on the current density than is the ionization efficiency of tungsten. The ionization efficiency of potassium at pressures below 10^{-7} mm Hg indicates a tungsten surface work function of 4.7 ev. The steep increase of the ionization efficiency with temperature due to cleanup of the surface allows the definition of a critical temperature. At cesium current densities below 10^{-1} ma/cm^2, these critical temperatures of porous tungsten are identical to those published by Taylor and Langmuir when measured at total pressure below 10^{-7} mm Hg; they increase relative to the Taylor and Langmuir data with current density. At a total pressure of 10^{-5} mm Hg and more, the critical temperature exceeds the Taylor and Langmuir data by about 180°K. The helium transmission coefficients of the eight porous pellets investigated are between 1.10^{-5} and 6.10^{-4}. In general, the transmission coefficient is not constant and decreases with time. (auth)

21829 EXPERIMENTS ON ATOM AND ION EMISSION FROM POROUS TUNGSTEN. Haywood Shelton (Space Tech. Labs. Inc., Redondo Beach, Calif.). p.219-28 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Experimental values of neutron cesium emission from hot porous tungsten ion emitters are presented. The most dominant influence on the 0.1% to 10% neutrals observed is the work function of the tungsten as altered by oxygen and contaminants on its surface. Oxygen reduces the neutrals, carbon that removes oxygen increases neutrals, and contaminants that lower the work function such as barium, zirconium, and thorium increase the neutrals. Higher temperatures above critical temperature and higher ion current densities increase the neutrals; higher applied voltages above that required to draw the space charge limited ion current reduce the neutrals slightly. The critical temperatures observed are about 100°K higher than would be expected from solid tungsten. (auth)

21830 IONIZATION, EMISSION, AND COLLISION PROCESSES IN THE CESIUM ION ENGINE. G. Kushevics, R. M. Worlock, and D. Zuccaro (Electro-Optical Systems Inc., Pasadena, Calif.). p.229-67 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Initial results of experiments on surface ionization of cesium on porous refractory metal ionizers indicate that critical temperature at 1 ma/cm^2 decreases in the following order: tantalum, niobium, rhenium, platinum, and tungsten. First pictures of cesium ion emission patterns were obtained in an ion microscopy experiment using a tungsten button and a lens. Electron emission from tantalum and copper was studied with incident cesium atom fluxes of 10^{14} to 10^{16} atom/cm^2-sec. Emission currents of 10^{-3} to 10^{-4} amp/cm^2 were observed for tantalum at surface temperatures of 525° to 600°K. Secondary electron emission due to cesium ion bombardment of copper was measured for 1 to 5 kv giving yields of 0.1 to 0.5. Sputtering by 2-kv cesium ions was measured for beryllium, titanium, molybdenum, tungsten, nickel, silver, gold, platinum, palladium, and copper. The plot of yield vs atomic weight of the target is similar to results reported in the literature for other ions. (auth)

21831 NEGATIVE IODINE FORMATION ON METAL HEXABORIDE SURFACES. W. D. Dong, W. D. Kilpatrick, J. M. Teem, and D. E. Zuccaro (Electro-Optical Systems, Inc., Pasadena, Calif.). p.269-89 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

The efficiency of making atomic iodine negative ions at a metal hexaboride surface using the mechanism of surface ionization was investigated. Molecular vapor was allowed to impinge on either a lanthanum or a gadolinium hexaboride coated filament of a Hull (d-c) magnetron. In the case of gadolinium hexaboride, the maximum current density, which was space-charge limited because of the available equipment, was 15 ma/cm^2. There appeared to be no fundamental physical reason why one could not obtain larger current densities. Furthermore, no evidence of surface contamination by iodine was observed. (auth)

21832 ELECTRON BOMBARDMENT ION SOURCE. Park French (Thompson Ramo Wooldridge Inc., Cleveland). p.291-8 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A mercury ion source for propulsive use was developed. Ionization of the propellant gas is accomplished by passing the gas through a dense cloud of oscillating electrons. The motion of these electrons is constrained by electric and magnetic fields so that very high circulating electron currents are obtained in the neighborhood of the source exit aperture. The presence of the high circulating electron currents results in almost complete ionization of the propellant leaving the source, yielding very high values for propellant utilization. Further, the high utilization is obtained at discharge power inputs of only several hundred watts per ampere of extracted ion current. The primary development effort on the source was devoted towards improvement of efficiency and propellant utilization through field and electrode geometry optimization. The level of

performance obtained appears satisfactory for propulsion applications. The source aperture is in the form of a long slit of the order of 1-mm width. This form allows considerable aperture area to be obtained while allowing close extractor electrode spacing. The close spacing permits operation at moderate extraction voltages, which is important in obtaining long engine lifetime. (auth)

21833 ELECTRON TRANSFER DISCHARGE ION SOURCE. Kenneth R. MacKenzie (Univ. of California, Los Angeles) and Ralph F. Wuerker. p.299-309 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

The transfer discharge is an ion source in which wall effects were eliminated. Electrons trapped in one longitudinal electric field potential well (and longitudinal magnetic field) are transferred by a longitudinal radio frequency field to an adjoining well, gaining energy in the process. By this technique, kinetic energy lost by inelastic collisions with neutral gas atoms is re-established cyclically; the discharge can be maintained without the aid of a thermionic source. The theory of operation is reviewed, and measurements as per question of efficiency of ion production are presented. From the standpoint of ion propulsion, the transfer discharge has the feature that it does not require internal cathodes that can be sputtered away by ion bombardment. (auth)

21834 IN-FLIGHT GENERATION OF FUEL FOR CESIUM ION ENGINES: THE CESIUM HYDRIDE SYSTEM. Ernest N. Petrick (Kelsey-Hayes Co., Romulus, Mich.), John A. Clark, and James C. Carter. p.311-40 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A study of fuel systems for cesium ion engines indicates that the generation of cesium by the thermal decomposition of the hydride offers distinct advantages when compared to the use of elemental cesium or the chemical reduction of cesium salts. The advantages of this method are discussed. The design of a cesium hydride feed system for a particular set of conditions is described. The system uses no moving components other than a valve. Various aspects of the system are considered, including the chemistry of CsH, its preparation and decomposition, a method for the separation of H_2 before passing through the emitter, and methods of flow rate control. Sufficient technological data are not presently available on all of these aspects to permit a finalized design, but the indicated advantages of the system warrant its continued investigation; a practical design appears feasible. (auth)

21835 CORROSIVITY AND CONTAMINATION OF CESIUM IN ION PROPULSION. J. H. Holley, G. R. Neff, F. B. Weiler, and P. M. Winslow (Hughes Aircraft Co., Culver City, Calif.). p.341-56 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Laboratory studies were conducted to evaluate problems of corrosion associated with cesium usage in ion propulsion. As part of the effort, an attempt was made to establish the effect that the resultant contamination has on the cesium propellant. Research grade cesium of 99.9% (minimum) was exposed to various containment materials for periods of 50 to 7000 hr at temperatures from room ambient to 1275°K. The primary containments detected were iron, chromium, nickel, and copper. (auth)

21836 ANALYSIS OF NEUTRALIZATION PROBLEMS USING THE ION ACCELERATOR COMPUTER PROGRAM. David C. Prince, Jr. and Russell N. Edwards (General Electric Co., Evendale, Ohio). p.357-78 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

The use of the Ion Accelerator Analysis Computer Program to study problems of ion beam neutralization is discussed. A simple annular ion beam is found to require extremely good local neutralization if excessive dispersion is to be avoided. Studies show that the interactions of parallel beams of positive and negative ions are not favorable to good mixing without considerable dispersion. (auth)

21837 NEUTRALIZATION OF ION BEAMS. L. D. Pearlstein, M. N. Rosenbluth, and G. W. Stuart (General Dynamics Corp., San Diego, Calif.). p.379-406 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

The existence of a neutralization problem for ion beam propulsion systems is predicted on the basis of the time-independent solutions of the relevant equations that predict large positive space charge. A one-dimensional model of the beam is investgiated that consists of an infinite slab of positive charge bounded by electrodes constrained to operate in the space-charge limited regime. It is demonstrated, using a variational principle derived from the Vlasov equation, that the electrons in such beams are unstable to infinitesimal perturbations. This behavior is a manifestation of the well-known two-stream instability, a collective phenomenon. Since the instability growth time is short compared to the other meaningful times, it is inferred that, at least for beams sufficiently small that the cathodes cannot operate emission-limited, the positive beam space charge cannot persist. The argument that collective instabilities lead to the neutralization of harmful space-charge effects is buttressed by the demonstration that beams with a small negative space-charge potential are stable. (auth)

21838 ONBOARD COLLOIDAL PARTICLE GENERATOR FOR ELECTROSTATIC ENGINES. Carl T. Norgren (National Aeronautics and Space Administration, Cleveland). p.407-34 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A method of colloidal particle generation based on the expansion and condensation of a material in a nozzle was investigated and is shown to be capable of supplying particles suitable for acceleration in an electrostatic engine. The material is heated in a small vaporizer that supplies a homogeneous vapor to a convergent-divergent two-dimensional nozzle 15.5 cm long with a rectangular throat 0.273 by 4.48 cm. Flow rate and subsequent particle growth are controlled by regulating temperature, and hence vapor pressure, of the material in the vaporizer. The experimental particle size determination was obtained by visual inspection of photographs taken in an electron microscope. It is demonstrated that particle size can be controlled from 0.005 to 0.05 μ and maintain narrow range distributions suitable for engine application. The colloidal generator was incorporated into a small specialized electrostatic engine. A negative corona discharge was used to charge the colloidal particles and a Pierce accelerator was used to accelerate these particles. A calculated thrust density of 5.60×10^{-3} newtons/m^2 at a specific impulse of 420 sec was obtained in engine operation. (auth)

21839 GLYCEROL DROPLETS FOR ELECTROSTATIC PROPULSION. Victor E. Krohn, Jr. (Space Tech. Labs. Inc., Redondo Beach, Calif.). p.435-40 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Charged droplets of glycerol containing dissolved anti-

mony trichloride were produced with narrow distributions of charge-to-mass ratio centered as high as 470 coul/kg and without significant numbers of ions accompanying the droplets. The distribution centered at 470 coul/kg would have a specific impulse of 2000 sec if it were accelerated through 430,000 v. (auth)

21840 PLASMA THERMODYNAMICS II, COMPLEX EQUILIBRIA IN NONIDEAL SYSTEMS. Henry A. McGee, Jr. (Georgia Inst. of Tech., Atlanta and National Aeronautics and Space Administration, Huntsville, Ala.) and Gerhard Heller. p.443-59 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A procedure for the computation of the thermodynamic properties of plasmas when considering the gas to be a complex, nonideal mixture was developed using a minimization of free energy technique. The plasmas may contain 6 elemental species that may be present in various states to form a total of 48 atoms, atomic ions, molecules, and molecular ions. The computed results for air were compared with earlier studies and were found to be in reasonable agreement. The population of excited levels as well as the thermal properties and equilibrium compositions over a rather course network of temperatures and pressures are presented for the hydrogen plasma which is the most interesting plasma from the point of view of electrothermal propulsion. The violation of certain requirements for thermodynamic consistency that results from the unrelated choice of an ionization energy decrement function and a real gas equation of state are discussed. When working with the lithium plasma, these considerations are shown to lead to a very large dependence on the path for thermodynamic calculations of the ordinary sort that involve differences in one of the energy functions. This effect is significant only because of the inordinately low ionization potential of this substance. (auth)

21841 THREE-FLUID NONEQUILIBRIUM PLASMA ACCELERATORS. [PART] I. S. T. Demetriades, G. L. Hamilton, R. W. Ziemer, and P. D. Lenn (Northrop Corp., Hawthorne, Calif.). p.461-511 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A three-fluid theory of nonequilibrium plasma flow is developed, and the underlying assumptions are discussed, with emphasis on crossed-field plasma accelerators. Use is made of a simplified model of the geometry of the discharge to analyze the effect of magnetic induction on the thrust at constant total current. The mechanism of current transfer between low-temperature electrodes is also discussed. Measurements are reported of mass flow rate, thrust, axial pressure distribution, total current, electrode voltage, magnetic induction, electrode and insulator erosion, and electrode cooling rates for a continuous crossed-field accelerator. The plasma generator and accelerator were connected by a gas-tight adapter and were both mounted on the thrust stand. Mass flow rates from 0.001 to 0.003 lbm/sec were used, and thrust levels of up to 3.6 lb were developed. Water cooled copper electrodes were employed with negligible erosion rates. Electrode power losses were about 20% of accelerator power. Accelerator running times are currently limited by test-tank heating to approximately 30 min at these power levels. The experimental results are shown to be in agreement with the theoretical analysis based on Cowling's three-fluid current density equation. On the basis of this analysis, operation at low flow rates and at higher power levels promises a specific impulse in excess of 6000 lbf-sec/lbm. Density optimization and staging can further increase the specific impulse. (auth)

21842 CHARACTERISTICS OF THE PINCH DISCHARGE IN A PULSED PLASMA ACCELERATOR. Leonard Aronowitz and Donald P. Duclos (Republic Aviation Corp., Farmingdale, N. Y.). p.513-30 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Electrical characteristics of a pulsed plasma accelerator were studied. The accelerator was operated at a maximum potential of 3 kv, a maximum energy of 540 joules, a maximum current of 235,000 amp, and a ringing frequency of about 165 kc. Plasma velocities up to about 9 cm/μsec and electron densities of the order of $10^{13}/cm^3$ were measured. Reproducibility of data was good for initial capacitor potentials above 2 kv. Below this voltage, reproducibility and symmetry of discharge deteriorated. Plasma velocity appeared to vary linearly with initial capacitor energy. (auth)

21843 EXPERIMENTAL STUDIES OF A REPETITIVELY FIRED TWO-STAGE COAXIAL PLASMA ENGINE. Bernard Gorowitz, Per Gloersen, and Warren A. Hovis, Jr. (General Electric Co., King of Prussia, Penna.). p.531-42 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A two-stage repetitively pulsed coaxial plasma accelerator was devised in an effort to minimize the switching and propellant injection problems associated with the repetitive operation of virtually all pulsed, high current discharge plasma sources. This engine was successfully fired at repetition rates up to 100 cps into a 3 × 13-ft vacuum chamber held at a pressure of 10^{-5} mm during operation. Power inputs of up to 25 kw were used with the second stage main discharge accelerator, whereas less than 100 w were supplied to the first-stage injector accelerator. Switching losses for the entire system, therefore, accounted for less than 1% of the entire power input. The specific impulse range of the accelerator as indicated by streak photography and photoelectric time-of-flight records of the motion of the luminous plasma are compared with that obtained from measurements of propellant mass flow and engine thrust. The results of spectroscopic determination of the composition of the plasma and the time-of-flight and time contours of the various plasma species are discussed. A test firing was completed on an engine operated at a 7-kw power level for 60 sec. (auth)

21844 INDUCTIVE HIGH-FIELD PLASMA ACCELERATORS. Ralph W. Waniek (Advanced Kinetics Inc., Costa Mesa, Calif.). p.557-71 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Theoretical and experimental results are presented on the acceleration of plasma by inductive coupling in strong magnetic field geometries. The requirements necessary for optimized operation are outlined in connection with the problems of plasma formation, containment, heating, and acceleration. Results obtained in experiments with strong-gradient high-field conical accelerators indicate an electrokinetic conversion efficiency around 5%, specific impulses of 10^5 sec in hydrogen and 10^4 sec in argon, accelerated masses around 10 μg/pulse, and forces up to 10^8 dynes/pulse. New types of contoured strong-field thrustors are introduced that are aimed at increasing the efficiency of the acceleration process. (auth)

21845 MEASUREMENTS OF IMPULSE OF A PULSED PLASMA ACCELERATOR. W. J. Guman, I. Granet, and J. Pearson (Republic Aviation Corp., Farmingdale, N. Y.). p.573-84 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A thrust stand that measures thrust directly is described. The principle underlying the design, i.e., the seismic pendulum, enables a very wide thrust range to be obtained by a simple alignment of the vertical axis of rotation relative to the line of action of gravity. A sensitivity of about 0.005 millipound-sec was achieved on one of the balances. Changes in the center of gravity of the propulsive device due to thermal expansion do not introduce errors in the readout. Electrical power, as well as signals to and from the propulsive system, is handled without affecting performance or accuracy of the balance. The calibrating unit is part of the balance, and a calibration can be carried out at any time by remote control while supporting a propulsive system. Tilting of the vacuum chamber during evacuation or due to thermal effects is automatically and correctly accounted for. (auth)

21846 LIMITATIONS ON THE SPACE TEST OF A CESIUM ION ENGINE AT ALTITUDES BELOW 1500 km. R. A. Hubach (Hughes Research Labs., Malibu, Calif.). p.587-600 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

It is demonstrated that in a space test there is a lower limit to the degree of electron-ion current imbalance of an ion beam that can be detected at altitudes below 1500 km. Thus, the electron and ion current emitted from the engine need not be exactly equal to prevent a net charge buildup on the vehicle. This apparently contradictory state can occur for two reasons: A nebulous plasma exists in the F_2-region of the atmosphere from which the vehicle can draw either electron or ion current to maintain its neutrality. The total ion current which can be drawn from such a plasma, however, is limited by the temperature and density of the plasma. The photoelectric current present when the vehicle is not shielded from the sun will cause a net electron flux from the vehicle. The amount of beam unneutrality that is masked by the plasma current is a function of altitude and time. Curves showing this altitude dependence are presented for both the diurnal maximum and minimum of plasma density. It is found that, at the altitude and time of maximum plasma density, the beam need be only 99% neutral for there to be no charge buildup on the vehicle. At an altitude of 1500 km during the diurnal minimum, this neutralization value is improved to greater than 99.99%. (auth)

21847 FLIGHT TEST CONCEPT FOR A PULSED PLASMA PINCH ENGINE. R. Loddengaard, S. Strauss, and A. Rifkin (Republic Aviation Corp., Farmingdale, N. Y.). p.601-15 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A flight test is considered for demonstrating the capabilities of a low thrust electrical engine as a propulsive device to effect small but additive changes in a satellite orbit. The program, based on a due-east launch into a nominal 300-naut mile orbit, is initiated with a Scout launch vehicle. By stabilizing the spin vector and controlling the firing of the engine with respect to its orbital position, predictable changes in the orbit are obtained. Description of the various perturbations, their effects on the spin vector orientation and the changes in the orbit are included. A 1500-w plasma pinch engine is used as the example. It is not operated continuously, as the average solar power is 60 w. A battery stores the collected energy and thus enables 4 min of engine firing in each orbit. In three months the apogee of the orbit will increase by more than 300 naut miles. The effect of drag and the interpretation of the effect of the engine on the orbit are discussed. These results, coupled with telemetry data, permit a thorough evaluation of the engine's short term and long term performance. (auth)

21848 PAYLOAD OPTIMIZATION FOR POWER-LIMITED VEHICLES. William G. Melbourne and Carl G. Sauer, Jr. (California Inst. of Tech., Pasadena). p.617-45 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

An analysis is presented for maximizing the payload of a power-limited vehicle by optimizing the control variables of the propulsion system and the values of the propulsion system parameters. A constant thrust program with coast capability is used. An exhaust velocity-dependent efficiency function for transmitting power from the vehicle powerplant to the exhaust beam is included in the optimization process. An approximate method of maximizing payload with respect to the propulsion system parameters is presented and is shown to yield very accurate results. These analyses were applied to a series of theoretical Earth-Mars rendezvous missions. (auth)

21849 CONCEPT FOR A MANNED MARS EXPEDITION WITH ELECTRICALLY PROPELLED VEHICLES. Ernst Stuhlinger and Joseph C. King (National Aeronautics and Space Administration, Huntsville, Ala.). p.647-64 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

A concept for a manned expedition to the surface of Mars, to take place in the early 1980's is presented. By using a fleet of five electrically propelled vehicles, high probabilities of mission success and crew safety are provided, whereas individual vehicle mass and complexity are kept within limits that appear reasonable for the time period considered. The five vehicles carry three men each and are similar in mass, design, and operating characteristics. Three vehicles carry high-thrust landing craft for transportation between the orbiting electric ships and the Martian surface. The other two carry compensating amounts of propellant during the outbound portion of the interplanetary journey. A constant, slow rotation of the large vehicles is maintained throughout the journey to provide a simulated gravity environment in the crew compartments. Each crew compartment contains a heavily shielded radiation shelter. The main vehicles are powered by fission reactors, from which electric power is derived by turbo-generator, thermionic, or plasma dynamic conversion techniques. The electrostatic thrust devices operate under constant conditions but are programmed in direction during the interplanetary transfer. Details on the flight plan, as well as conceptual design data on the vehicles, are presented. (auth)

21850 POTENTIALITIES OF AIR-SCOOPING ELECTRICAL SPACE PROPULSION SYSTEMS. R. H. Reichel, T. L. Smith, and D. R. Hanford (Boeing Co., Seattle). p.711-43 of "Electric Propulsion Development." New York, Academic Press Inc., 1963.

Mission and system interactions and optimizations when using planetary atmospheres as a source of propellant for electrostatic or electromagnetic propulsion systems are considered. The concept consists of injecting the space vehicle minus propellants into a low-altitude orbit, simultaneously scooping and liquefying air as well as overcoming drag, and then executing the space mission with the same vehicle. A comparison is made with all-chemical, chemical/nuclear, and conventional electrical propulsion systems, using for the latter ones values for the specific powerplant mass of 1, 5, 10, and 20 lb/kw. It can be seen that for any advanced space mission the electrical propulsion system, air-scooping or conventional, is superior to

the high-thrust chemical or nuclear booster system. Comparing electrical systems, the magnitude of the specific powerplant mass determines the limit of economical operation regions between air-scooping and conventional electrical systems. On the basis of the payload improvement factor as a function of the round-trip requirement, it can be concluded that, the higher the required velocity increment, the more the scooping vehicle pays off. (auth)

21851 PULSE GENERATOR (Engineering Materials). (California. Univ., Livermore. Lawrence Radiation Lab.). 1 drawing. (CAPE-794)

The pulse generator has a sweeping amplitude of 5 sec and 60 sec with voltage 0 to 5 v. It consists of an unregulated power supply 375 v, d-c and 125 ma, a regulated power supply 135 to 165 v, 50 ma and a 200 ma regulator. Also used are a balanced d-c amplifier, cathode follower, relay driver, buffer, chopper, and an amplifier. (F.L.S.)

21852 NEUTRON FACILITY (Engineering Materials). (California. Univ., Livermore. Lawrence Radiation Lab.). 140 units. (CAPE-800)

The neutron facility consists of a chemistry box 65 in. long by 48 in. by 48 in. made of 11 gage cold rolled, mild steel, with a water window. There is a polyethylene lined storage well, transfer box and carrier, a magnetic lift capable of lifting 500 lb, an overhead crane, and a manipulator device capable of raising and lowering 65 lb. (F.L.S.)

21853 PLASTIC GLOVED BOX (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). An assembly and 1 drawing. (CAPE-861)

The box is useful in housing short-term experiments with radioisotopes to contain the emitted beta and low energy gamma radiation or limited amounts of alpha activity. The box is $46\frac{7}{8}$ in. by $34\frac{1}{4}$ in. by $20\frac{1}{8}$ in. It has two ports $8\frac{11}{16}$ in. in dia. The box is constructed of fire-resistant, self-extinguishing, polyester resin that is reinforced with glass fibers. The design combines strength with lightness and economy. (F.L.S.)

21854 HIGH INTENSITY FOOD IRRADIATOR FACILITY (HIFI) (Engineering Materials). (Curtiss-Wright Corp., Princeton, N. J.). 21 units. (CAPE-885)

The facility is used to treat food and other materials with gamma radiation, using a multimega curie Co^{60} source. The radiation cell is 32 ft 8 in. long, 22 ft wide, and 11 ft high, and has an access corridor 7 ft wide. The shielding walls consist of 6 ft of compacted sand between 8 in. thick walls. The roof of the cell has a $5\frac{1}{2}$ in. concrete slab which is covered with 7 ft of compacted sand. The source has 2,500,000 curies and is a plaque type radiator. Items to be exposed will require doses in the range of 8,000 to 5,000,000 rads. The facility will process, at a rate of 3,000 lb per hr, up to 2 megarads. The radiator cell temperature is controlled within 10° over a range from ambient temperature to +10°F. (F.L.S.)

21855 THOREX FACILITY BUILDING (STRUCTURAL, ELECTRICAL AND MECHANICAL DRAWINGS) (Engineering Materials). (Oak Ridge National Lab., Tenn.). 91 units. (CAPE-886)

The concrete building consists of a basement, first floor, and attic with dimensions of 214 ft 8 in. long and 33 ft wide. A concrete platform, 174 ft long and 15 ft wide, has a small room opening onto it from the building. This room is 22 ft 6 in. wide × 12 ft 6 in. long. The Austin Co., New York, and Du Pont de Nemours (E. I.) and Co., Wilmington, Del., were subcontractors for Clinton Engineering Works, Manhattan District, Oak Ridge, for this project (see also CAPE-370 for drawings on the Thorex Process Equipment). (F.L.S.)

21856 BAG PASSOUT SEALER FOR WATER-SHIELDED CAVE FACILITY (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). 31 drawings and 2 photographs. (CAPE-912)

The water-shielded cave facility is used in processing irradiated slugs for recovery of americium, curium, berkelium, californium, einsteinium, and fermium. The remotely operated, plastic-bag passout sealer is used in removing isotopic fractions for storage in the rear or for removing radioactive waste for placement in the waste storage containers. The unit is accessible by both the primary inclosure master-slaves and the service area master-slaves. (F.L.S.)

21857 MICROSCOPE STAGE, 12 CM × 12 CM, STAGE II-C DIGITAL COUNTER (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-913)

The stage is used for efficient scanning of 6 in × 9 in. and larger emulsion plates. It weighs 17 lb and may be attached directly to a conventional microscope-stand with additional bracing. Travels on the stage are 12 × 12 cm. Measuring accuracy approaches 2μ per cm. (F.L.S.)

21858 IN-PILE LOOP PUMP, 5 GPM (Engineering Materials). (Oak Ridge National Lab., Tenn.). 12 drawings. (CAPE-920)

This small, canned-rotor, centrifugal-type pump is used to circulate fuel solutions in a loop, and it is designed for 5 gpm flow against a head of 40 ft when pumping solution at 300°C and 2000 psi. Parts of the pump exposed to the circulating fluid are of type 347 stainless steel. The single stage pump is of simple design, 6 in. in dia., and 12 in. in length, and is not reusable. The solution in the pump rotor and bearing region and the stator windings are cooled by circulating water through a cooling jacket on the pump and cooling coils which are clamped into slots in the stator. (F.L.S.)

21859 BIRDCAGE, 5 IN. CYLINDER SHIPPING CONTAINER (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). 2 drawings. (CAPE-941)

The birdcage is used with a 5 in. cylinder shipping container. It is $36\frac{7}{8}$ in. high, $42\frac{7}{8}$ in. high including the cap, and is 30 in. sq. The wood frame is covered with 18 gauge expanded metal, $\frac{1}{2}$ in. standard mesh. This cylinder can be used with the birdcage to transport 55 pounds of uranium hexafluoride (see CAPES-323, 324, and 862 for additional uranium hexafluoride shipping containers). (F.L.S.)

21860 COBALT TELETHERAPY SOURCE (WELDED TYPE) (Engineering Materials). (Oak Ridge National Lab., Tenn.). 1 drawing. (CAPE-947)

This teletherapy source is used with Co^{60} wafers, which are placed in a 0.02 in. stainless steel container of 0.794 ID. It is 0.995 in. high with a 0.125 in. top plug. This inner container is surrounded by a tungsten alloy spacer 1.544 in. OD_1 1 in. high, and 0.324 in. thick. There is a tungsten alloy plug 1.484 in. in dia and 0.843 in. high. The 0.02 in. stainless steel outer container is 0.847 in. ID and 1.151 in. high. (F.L.S.)

21861 HIGH TEMPERATURE FURNACE (Engineering Materials). (National Carbon Co., Cleveland). 6 drawings. (CAPE-949)

The high temperature furnace is used in studying isothermal fuel migration in graphite-matrix nuclear fuel elements. It consists of a cold trap 4 in. OD, $3\frac{3}{4}$ in. ID, $8\frac{3}{4}$ in. high, of stainless steel; and a second cold trap $3\frac{1}{8}$ in. in dia. and $6\frac{3}{4}$ in. high; a table 25 in. by 42 in. with an added section 14 in. by 14 in. The table is 28 in. high. The furnace

body is 18⅛ in. high and 12 in. OD with 3/16 in. thick stainless steel. A MCF-300 diffusion pump and a Vuco vacuum valve-150-5 are required. The electrodes are copper and the furnace is cooled by water in a ¼ in. tubing spiralling around the furnace. (F.L.S.)

21862 GLOVE BOX—INTRODUCTION PORT (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). 3 units. (CAPE-951)

The port used for introducing materials into a glove box is a door made in two sections. The inner section is ½ in. thick and 10¼ in. in dia. The outside of the door is 9⅞ in. in dia. and ½ in. thick. Light teflon-covered "Q" rings separate the two parts of the door. A teflon washer is used at the knob. (F.L.S.)

21863 HIGH VACUUM VALVES FOR THE ACCELERATOR PROGRAM (Engineering Materials). (Oak Ridge National Lab., Tenn.). 44 drawings. (CAPE-960)

Twenty-two high vacuum valves used in the accelerator program are included in this package, and also an all metal seal for a high vacuum valve. Valves included are: ¼ in. through type, manual; 1 in. through type; 2 in. slide, air operated; 2 in. slide; 2 in. slide for Cockcroft-Walton accelerator; 2 in. special type; 2 in. for 2.5 Mev Van de Graaff accelerators; 2 in. penumatic cylinder; 2 in. slide for standard beam plumbing; 3 in. angle type; 3 in. angle, air operated; 3 in. angle, pneumatic; 4 in. angle type; 4 in. air operated; 4 in. right angle, bellows; 5 in. angle, air operated; gas supply valves, and gear drives; and needle and thermal gas leak. (F.L.S.)

21864 COBALT-60 IRRADIATION FACILITY (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). 3 drawings. (CAPE-961)

The underwater irradiation facility is used to study the effects of gamma radiation on various materials. The source contains 11,500 curies of Co^{60} with field intensity range from 6.4×10^3 to 2.2×10^6 r/hr. Samples up to 3 in. in dia. and 6 in. long may be irradiated. The economical facility is under water and routine work in adjacent areas may be continued at all times. (F.L.S.)

21865 PK PRIMARY NaK PUMP, 1600 GPM (Engineering Materials). (Oak Ridge National Lab., Tenn.). 69 units. (CAPE-962)

This sump-type centrifugal pump has a capacity of 1,600 gpm for circulating NaK at temperatures up to 1,500°F in heat transfer and reactor experiments. This pump is designed so that it may be located adjacent to the reactor in high radiation fields. The pump has two parts, the rotary and stationary elements. The rotary element is removable for easy maintenance. Included in this is the bearing housing, the shaft, the impeller, and the thermal baffles. The stationary element includes the pump tank, volute, and the inlet and discharge nozzle. (F.L.S.)

21866 PULSE PUMP—4 INCH (Engineering Materials). (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). 12 drawings. (CAPE-968)

This pump or pulser is used to pulse a column for countercurrent liquid-solids. The column, which is used to handle various phases of nuclear fuel processing, is connected to the pump with a connecting rod. A variable speed motor allows the amplitude to be varied from 0 to ½ in. and the frequency from 0 to 2,000 cpm. The pump is a piston type with a 3.991 ± 0.001 in. dia piston. (F.L.S.)

21867 APPARATUS FOR SLITTING HOLLOW CONTAINERS HAVING FINS ON THEIR EXTERNAL PERIPHERY. Maldwyn Hugh Roberts and David Warwick Lloyd Clamp (to Joseph Lucas (Industries) Ltd.). British Patent 921,261. Mar. 20, 1963. Filed Jan. 29, 1960.

An apparatus is designed for cutting the can of a fuel element to a predetermined depth without coming into contact with the fuel. The apparatus comprises a slitting wheel, feeler means for sensing the contour of the can, and means for allowing for the fin thickness in the cutting operation. (D.L.C.)

21868 IMPROVEMENTS IN OR RELATING TO INTERCHANGEABLE CONTROL COCKS. Pierre Roubeau and Paul Chaumette (to Commissariat à l'Énergie Atomique). British Patent 924,183. Apr. 24, 1963. Priority date Apr. 16, 1959, France.

A control cock for pipelines for liquefied gases at low temperatures is designed which is simple to construct, assemble, and dissemble and which has good thermal insulation. The opening and closing of the cock is effected by liquid-operated piston and spring means. (D.L.C.)

21869 SAMPLE CAN HANDLING MECHANISM. William D. Egnor and Gordon L. Romine (to U. S. Atomic Energy Commission). U. S. Patent 3,090,480. May 21, 1963.

A remotely operated turntable is described for moving containers in succession from station to station and holding the containers in position at each station while a desired operation is performed. The assembly is capable of both vertical and rotational movements and is equipped with means that limit the rotational movements to predetermined angular increments and means that prevent rotation of the turntable while the container is at a work station. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstracts 22909 and 22918.

21870 (ANL-6675) NUCLEATE BOILING CHARACTERISTICS AND THE CRITICAL HEAT FLUX OCCURRENCE IN SUBCOOLED AXIAL-FLOW WATER SYSTEMS. R. J. Weatherhead (Argonne National Lab., Ill.). Mar. 1963. Contract W-31-109-eng-38. 34p.

An empirical analysis is used to equate the pressure term in the Jens-Lottes nucleate boiling wall superheat equation to the liquid coolant surface tension, which modifies the equation to $T_w - T_f = 0.18 \times 10^6 \sigma (Q''/10^6)^{1/4}$ for surfaces of "average" nucleation capability. This equation is used to determine the pressure dependency of several nucleate boiling characteristics, including proportionate nucleate bubble sizes. The pressure dependency of the nucleate bubble-size characteristic is shown to be virtually identical with the pressure dependency of the mass-velocity term in the Jens-Lottes subcooled water critical heat flux correlation. Other alterations and additions are explained, and the modified form of the equation: $Q''_c/10^6 = (2/3)\, D_e^{-1/4} (H_{fg}/10^3)(G/10^6)^m [1 + \tanh (H_f - H/100)]$, with $m = 0.175 \times 10^{-3} (v_{fg}/H_{fg})^{-1}$, is compared with data for circular and rectangular flow channels. Several subcooled boiling flow regimes are hypothesized and explained to account for the unusual effect of the mass velocity upon the critical heat flux in the low-subcooling, low-steam-quality region. A pronounced surface effect, paralleling the nucleate boiling surface effect, upon the critical heat flux occurrence at the higher subcoolings is illustrated and used to explain apparent discrepancies within and among several representative bodies of critical heat flux data. (auth)

21871 (CISE-R-53) FURTHER INVESTIGATIONS IN ADIABATIC DISPERSED TWO-PHASE FLOW: PRESSURE

DROP AND FILM THICKNESS MEASUREMENTS WITH DIFFERENT CHANNEL GEOMETRIES— ANALYSIS OF THE INFLUENCE OF GEOMETRICAL AND PHYSICAL PARAMETERS. N. Adorni, I. Casagrande, L. Cravarolo, A. Hassid, E. Pedrocchi, and M. Silvestri (Centro Informazioni Studi Esperienze, Milan). Jan. 1963. Work Performed Under United States–Euratom Joint Research and Development Program. Contract 060-61-7-RDI. 105p. (EURAEC-595)

Experimental data obtained at CISE on two-phase adiabatic flow are presented. The measured quantities are pressure drop and liquid film thickness on the inner and the outer wall of the conduit. The pressure loss and film flow rate are evaluated. The experimental data are discussed and the effects of various physical and geometrical parameters are investigated. A simple relation for the pressure loss in adiabatic dispersed regime is given. (auth)

21872 (CISE-R-62) DESCRIPTION OF A LOOP FOR HEAT TRANSFER EXPERIMENTS WITH STEAM–WATER MIXTURES (PART I) AND OF PRESSURE DROP MEASUREMENTS IN ADIABATIC CONDITIONS (PART II). Topical Report No. 3. N. Adorni, A. Alessandrini, S. Bertoletti, G. P. Gaspari, C. Lombardi, G. Peterlongo, G. Soldaini, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Dec. 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 060-61-7-RDI. 102p. (EURAEC-589)

The components and the instrumentation of a loop that has been built in order to measure critical heat flux, heat transfer coefficient and pressure drop with steam-water mixtures are described as well as the calibration and the experimental procedures. The computed code used for data elaboration is analysed in detail and the errors on the output data discussed. Pressure drop measurements made in adiabatic conditions are examined. The data obtained in single phase flow are checked against existing correlations. The data obtained in two phase flow are discussed in the light of previous correlation attempts. An attempt is made at interpreting the different trends found for pressure drop data in the quality region in terms of different flow patterns. (auth)

21873 (CISE-R-63) CRITICAL HEAT FLUX DATA FOR FULLY DEVELOPED FLOW OF STEAM-WATER MIXTURES IN ROUND VERTICAL TUBES. Topical Report No. 4. S. Bertoletti, G. P. Gaspari, C. Lombardi, G. Peterlongo, M. Silvestri, G. Soldaini, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Nov. 1962. Work Performed under United States–Euratom Joint Research and Development Program. 51p. (EURAEC-517)

Data are presented for pressures of 71.5 kg/cm^2 abs. The tube length-to-dia. ratio range in the experiments was 3.61 at the lower limit to 295.1 at the upper limit. The analysis of these data is in progress. (J.R.D.)

21874 (LADC-5766) TWO-PHASE p-H_2 FRICTION FACTOR. John D. Rogers (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 19p.

A means for estimating two-phase friction factors for p-H_2 for pressures between one atmosphere and the critical pressure was devised. The Martinelli model is used. The ϕ-X-P-x and the R_f-X-P-x surfaces are developed for a totally turbulent system. The two-phase friction factor ϕ can be determined uniquely from pressure and quality. Fluid moduli, α and β, of the Martinelli model take on additional physical significance. (auth)

21875 (NASA-TN-1534) A NUMERICAL SOLUTION OF THE PROBLEM OF MIXING OF LAMINAR COAXIAL STREAMS OF GREATLY DIFFERENT DENSITIES—ISOTHERMAL CASE. Herbert Weinstein and Carroll A. Todd (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Feb. 1963. 26p.

An analysis that is valid throughout the entire region of mixing is presented. The unique features of the analysis are the diffusion equation employed to make the solutions valid at high density ratios and the manner in which the variables are made dimensionless. No consideration is given to the hydrodynamic stability of the system. An equation set is derived and solved numerically for several sets of input parameters. The results include curves of velocity and concentration profiles, radial average velocity, and average inner fluid density. The effect of physical property values is also shown. (auth)

21876 (NP-12742) THE PREDICTION OF LOW QUALITY BOILING VOIDS. Technical Report No. 23. Peter Griffith (Massachusetts Inst. of Tech., Cambridge). Jan. 1963. Contract NONR-1841-(39). 34p.

Slug-flow theory was used to predict the density in heated channels of various shapes. In order to make this calculation possible, measurements were made of the bubble rise velocity in annuli, tube bundles, and channels. It was found that the large dimension is most important in channels and the shroud dimension most important in annuli and tube bundles. It is also found that no rotationally symmetrical bubble shapes are obtained in annuli and tube bundles. Results of a comparison made between the theory, which contains no free constants, and the experiments agree. The results, as presented, apply only to vertical heated channels of various shapes with up flow in the low-quality region. (auth)

21877 (ORNL-TM-534) CONDENSING FLOW IN FINNED, TAPERED TUBES. R. B. Korsmeyer (Oak Ridge National Lab., Tenn.). May 1, 1963. Contract W-7405-eng-26. 42p.

On the assumption that a Lockhart-Martinelli type of correlation is applicable, an analytical approach to the interpretation of pressure drop data on condensing flow in tapered tubes was developed with particular reference to the condensation of potassium in a radiant condenser of a type that may be attractive for space power plants. It appears that instability can be encountered in such condensers only through the introduction of excess liquid inventory at reduced power or by design of the condenser for insufficient pressure drop at design power. (auth)

21878 (TID-18512) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for Month of March 1963. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Mar. 29, 1963. Contract AT(30-3)-187. 10p. (MPR-XIII-3-63)

The analysis of two-phase pressure drop data obtained from the operation of the 6 ft 19-rod test section was completed. Application of a modified Martinelli-Nelson correlation produced nearly identical results to those obtained earlier for the first 3 ft 19-rod test section. The ratio of two-phase pressure drop to single-phase liquid pressure drop plotted versus average steam quality was again observed to be independent of mass velocity. Good agreement with results for the 3 ft bundle was also obtained on a simple plot of total pressure drop per unit length versus average steam quality with mass velocity as a correlating parameter. (auth)

21879 (TID-18556) HEAT TRANSFER IN LAMINAR FOG FLOW. Technical Report No. 13. Rollin C. Dix and P. W. McFadden (Purdue Research Foundation, Lafayette, Ind.). Sept. 1962. Contract AT(11-1)-1177. 121p.

A mathematical model for heat transfer in laminar fog flow was developed; and an analog computer was used to solve the equation for steady, laminar, fully developed fog flow heat transfer in the entrance region of tubes. The results indicate that for a given fluid and geometry increasing the drop size for constant quality decreases the heat transfer rate, and decreasing the quality for constant drop size extends the length over which the heat transfer rate is increased by the two phase nature of the flow. An apparatus was constructed for testing this result. Although experimental heat transfer coefficients for single phase runs differed from accepted values by 12%, fog flow data confirmed the analog computer results and showed that the fog flow model does correctly represent the basic fog flow heat transfer characteristics. (D.C.W.)

21880 (TID-18569) STABILITY OF VISCOUS FLOW HEAT EXCHANGE. Conrad Longmire (Los Alamos Scientific Lab., N. Mex.). July 11, 1955. Contract [W-7405-eng-36]. 8p.

Dimensionless flow and heat equations are given, and steady and time-dependent solutions are examined for stability. A perturbation method is used to study stability in the region of a steady solution. (D.C.W.)

21881 (TRG-Report-447) HEAT-TRANSFER CHARACTERISTICS OF ROUGHENED SURFACES. N. Sheriff, P. Gumley, and J. France (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). Mar. 7, 1963. 23p.

An experimental program was carried out to provide a heat-transfer surface with an improved power law for use in a reactor fuse. Roughened surfaces of small roughness heights, 0.010 and 0.020 in., were studied to achieve the necessary improvement. Analysis of the results in terms of the ratio of the roughness height to the laminar sublayer indicates that a general correlation for rough surfaces might be possible. (auth)

21882 (NP-tr-997) THERMAL CONDUCTION IN SOLIDS. J. Tavernier. Translated by R. R. Inston (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Onde Elec., 42: 541-53(1962). 36p.

Mascroscopic and microscopic aspects of the thermal conductivity of solids are examined. By using analogies between electric and thermal conductivity the possibility of an indefinite wave propagation velocity increase is eliminated from the heat propagation equation based on the Fourier hypothesis. Contributions of lattice waves, spin waves, and charged carriers to energy transfer are investigated, and a theory of energy transfer based on phonon motion is developed. (D.C.W.)

21883 (TRG-Inf-Ser-267) HEAT-TRANSFER CRISIS IN STEAM-GENERATING CHANNELS. M. E. Shitsman. Translated by D. R. H. Phillips (U.K.A.E.A. Reactor Group, Risley, Lancs, Eng.) from Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR, 5: No. 9, 9-15(1962). 9p.

From an analysis of the experimental data of a number of authors on the heat-transfer crisis in steam-generating channels, a clear relationship is established between the values of the critical heat fluxes and the length of the steam-forming part of a channel. (auth)

21884 (TRG-Inf-Ser-291) THE INFLUENCE OF SURFACE ROUGHNESS ON THE RESISTANCE TO FLOW OF LIQUIDS AND ON CONVECTIVE HEAT EXCHANGE. B. M. Teverovskii. Translated by R. Hardbottle (U.K.A.E.A. Reactor Group, Risley, Lancs, Eng.) from Izv. Vysshikh Uchebn. Zavendenii, Energ., No. 7, 84-9(1958). 8p.

Experiments show that convective heat transfer can be improved by roughing the interior of the pipes. Relations used are given, and power requirements for pumping through roughened and smooth pipes are compared. Resistance to flow was also measured. (D.C.W.)

21885 HEAT TRANSFER TO LIQUID METALS FLOWING THROUGH A PIPELINE. V. M. Borishanskii, T. V. Zablotskaya, and N. I. Ivashchenko. At. Energ. (USSR), 14: 320-2(Mar. 1963). (In Russian)

A scheme involving the superposition of three layers of heat flow onto the high thermal-conductivity liquid flowing with a Prandtl number $Pr \ll 1$ was previously proposed (Atomnaya Energ. 11, 426(1961) No. 5; also Second Conference on Theoretical and Applied Magnetohydrodynamics, Riga, 1962). The analytical determination of these thermal layer boundaries was based on the premise that the dimensionless temperature and velocity fields coincide in the region where the dynamic and thermal cores are turbulent; the boundary of the adherent layer in which molecular transfer takes place was determined by a newly derived formula. Results of the calculations of two variants of the superimposition of thermal and dynamic layers were plotted and compared with each other. For an experimental study, the heat transfer to liquid Na flowing through a 40-mm-diam. vertical Cu pipe was determined. The results agreed well with the values obtained by the three-layer calculations. Determination of the O content of Na showed that the heat transfer is dependent on the average O content and also on the flow rate of the Na stream. As the O content that was encountered exceeded the solubility limit, a portion of the oxides was probably present in the suspended state. (TTT)

21886 APPROXIMATION THEORY OF HEAT TRANSFER IN DEVELOPED BUBBLE BOILING. D. A. Labuntsov. Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Energ. i Transp., No. 1, 58-71(Jan.-Feb. 1963). (In Russian)

A theoretical approximation of heat transfer during bubble boiling was expounded. An analysis was made of bubble development on the heating surface, of parameters determining the number of acting boiling centers, and of bubble growth on the heating surface. A model and calculational scheme for heat transfer were suggested, and an approximation of mean interactions was given. (tr-auth)

21887 SURFACE RECOMBINATION AND HEAT TRANSFER IN A DISSOCIATED DIATOMIC GAS. PART I. W. B. Cottingham (Bell Telephone Labs., Whippany, N. J.) and R. J. Grosh. J. Heat Transfer, 85: 101-6(May 1963).

A method is described for the investigation of surface catalytic effects and heat transfer in a dissociated diatomic gas. The experimental apparatus and the method and theory of testing are described. (auth)

21888 SURFACE RECOMBINATION AND HEAT TRANSFER IN A DISSOCIATED DIATOMIC GAS. PART II. W. B. Cottingham (Bell Telephone Labs., Whippany, N. J.) and R. J. Grosh. J. Heat Transfer, 85: 107-10(May 1963).

Results are presented for the recombination coefficient of hydrogen atoms on a stainless-steel surface as a function of pressure, temperature, and concentration. These results are compared with theoretical predictions. Results are also presented for a heat-transfer ratio. The results cover a range of Knudsen numbers from 0.08 to 4.2, a

range of Reynolds numbers from approximately 0.004 to 0.2, and an upstream Mach number of approximately 0.1. (auth)

21889 PREDICTION OF TWO-PHASE PRESSURE DROP AND DENSITY DISTRIBUTION FROM MIXING LENGTH THEORY. S. Levy (General Electric Co., San Jose, Calif.). J. Heat Transfer, 85: 137-52(May 1963).

Single-phase turbulent mixing length methods are used to predict two-phase flow. Two-phase density and velocity distributions and two-phase pressure drops are derived by treating the two-phase system as a continuous medium where the turbulent exchanges of momentum and density are equal. Good agreement is obtained between test results and analytical predictions. (auth)

21890 AVERAGE TEMPERATURES IN SIMPLE HEAT EXCHANGERS. T. R. Bump (Argonne National Lab., Ill.). J. Heat Transfer, 85: 182-3(May 1963). (TID-17100; UAC-6791)

An equation is derived for the expression of the average fluid temperature $R = (T_1 - \overline{T})/(T_1 - T_2) = [1/(1 - r)] + [1/\ln r]$, where T_1 = hot fluid inlet temperature, $\overline{T}$ = average hot fluid temperature, T_2 = hot fluid outlet temperature, t_1 = cold fluid inlet temperature, t_2 = cold fluid outlet temperature, and $r = (T_2 - t_1)/(T_1 - t_2)$ for counterflow and $(T_2 - t_2)/(T_1 - t_1)$ for unidirectional flow. A graph of R vs. r is given. (D.L.C.)

21891 MODEL STUDY OF THE HEAT TRANSFER ALONG A POLYZONAL SPIRAL FUEL ELEMENT CAN. S. B. H. C. Neal and J. A. Hitchcock (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Nucl. Eng., 8: 170-3(May 1963).

An investigation was conducted on the puzzling variation in heat transfer along the length of the can of a polyzonal spiral fuel element. The heat transfer characteristics were studied in a rig using a four times scale model of the fuel element. The axial heat transfer variation was found to be caused by a combination of flow and temperature effects, the former being more important. The use of an unheated can or a ring Venturi upstream of the can improves the heat transfer, and other ways of improving the flow are discussed. (D.L.C.)

21892 NEW CORRELATIONS PREDICT DNB CONDITIONS. L. S. Tong, H. B. Currin, and A. G. Thorp, II (Westinghouse Electric Corp., Pittsburgh). Nucleonics, 21: No. 5, 43-7(May 1963).

Separate treatment of the data for quality and subcooled regions yields two empirical relations that successfully predict departure from nucleate boiling over the full range of conditions found in power-reactor cores. (auth)

21893 TURBULENT FLOW OF CONDUCTING FLUID IN RECTANGULAR TUBES UNDER ELECTRODYNAMIC PONDEROMOTIVE FORCES. A. G. Ryabinin and A. I. Khozhainov. Zh. Tekhn. Fiz., 33: 80-9(Jan. 1963). (In Russian)

Magnetohydrodynamic equations were used for determining the effects of rectangular tubes and transverse magnetic fields on conducting turbulent flow. Formulas were developed for the total friction factor in magnetohydrodynamic flow, and correlations were made of theoretical and experimental data for a wide range of Re and M. (tr-auth)

21894 THE EFFECT OF AXIAL TURBULENCE PROMOTERS ON HEAT TRANSFER AND PRESSURE DROP INSIDE A TUBE. Lawrence Boyd Evans. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 245p.

The rate of heat transfer and the pressure drop were measured with water flowing through a tube containing turbulence promoters. Disks and streamline shapes of several sizes were mounted at various uniform spacings along a small rod, axially centered inside the tube. The effect of solid axial cores on the rate of heat transfer from the outside wall of the annulus formed by the cores was also investigated. A uniform heat-flux density was imposed at the tube wall by electrical generation of heat in the wall. Local heat-transfer coefficients along the length of the tube were determined from measurements of the longitudinal wall temperature distribution and heat-flux distribution. The over-all rate of heat transfer was obtained by numerical integration of the local rates. Generalized empirical correlations are presented for the over-all heat-transfer coefficient and the effective drag coefficient for disks and streamline shapes. A method is developed for determining the economic feasibility of using any device for turbulence promotion. The method is used to compare the effectiveness of the disks, streamline shapes, and solid cores studied in the experimental phase of the investigation. It is shown that in certain applications a distinct monetary savings can be realized by the use of the proper promoter. It is also shown that turbulence promoters can be used to provide additional flexibility in the design of a new heat exchanger or in the improvement of an old one. The effect of installing turbulence promoters is shown to be very similar to that of providing additional tube passes. (M.P.G.)

21895 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS PARTICULARLY FOR NUCLEAR REACTORS. Harold John Coles and John Mackintosh Sutherland (to Mitchell Engineering Ltd.). British Patent 924,137. Apr. 24, 1963. Filed June 19, 1958.

A heat exchanger is designed for generating steam by heat exchange with steam produced in a reactor. The heat exchanger comprises an upper casing and a lower casing, with enclosed tubes extending from the upper casing into the lower casing for heat exchange therebetween. One advantage of the heat exchanger is that the tubes are attached at only one end to the casing and hence are free to expand and contract independently of the casing. (D.L.C.)

Materials Testing

Refer also to abstracts 22095 and 22203.

21896 ROLLING-STAND FOR STRUCTURAL MEMBERS OF A SHIP WITH NUCLEAR PROPULSION. D. Ulken (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt e. V., Geesthacht, Ger.). Kerntechnik, 5: 63-5 (Feb. 1963). (In German)

The influences of sea motions and machine vibration cause additional high stresses on the structural members of a ship reactor. To achieve the required high safety in operation, it is necessary to test new constructions prior to their installation in a ship. It is intended to make sure that the functions of control-rod drives and instruments and the durability of control-rods and fuel elements undergo thorough testing on a so-called rolling-stand. This test-stand is able to simulate ship motions both at sea and in case of accidents. The design and first experience with the rolling-stand are described. (auth)

21897 ZIRCALOY CLADDING THICKNESS TESTER (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). 18 drawings. (CAPE-953)

The eddy current tester will measure Zircaloy over uranium metal in the range of 5 to 25 mils, Zircaloy over UO_2 in the range of 20 to 40 mils, and the wall thickness of Zircaloy tubes in the range of 20 to 40 mils. The thickness is measured with an accuracy of 1 mil. Probes may be used on tubes with inside diameters ranging from 0.66 to 1.70 in. and outside diameters ranging from 1.02 to 2.50 in. The tester may also be used for spot measurements with hand-held probes, or a continuous scan of the tubes may be made by mounting the probes on a mechanical feeder. Sensitivity of the instrument to changes in probe-to-sample spacing not exceeding 4 mils is minimized by circuit design and probe mounting technique. $0.50(OTS) (F.L.S.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstracts 21846 and 21921.

21898 (AFCRL-62-380) INVESTIGATIONS OF PROPERTIES OF THE AURORAL ZONE IONOSPHERE BY MEANS OF RADIOASTRONOMICAL SWEPT-FREQUENCY INTERFEROMETER, COVERING THE FREQUENCY BAND 35-65 Mc/s. Scientific Report No. 4. Ludwik Liszka (Sweden. Kungliga Vetenskapsakademien. Geofysiska Observatoriet, Kiruna). Feb. 1, 1962. Contract AF61(514)-1314. 16p. (AD-282198)

A discussion of results obtained with the help of a radioastronomical swept-frequency interferometer at Kiruna Geophysical Observatory during the months March–December, 1961 is presented. A special type of increase of the broad-band radiation intensity of the radio-source Cassiopeia was observed. This seems to result from the focusing effect of single ionospheric regions of a size larger than the first Fresnel zone. An investigation of correlation of the increases with other geophysical parameters was also made. (auth)

21899 (AFCRL-62-1071) A STUDY OF PROCESSES IN THE IONOSPHERE BY MEANS OF GYRO-INTERACTION EXPERIMENTS CARRIED OUT WITH ROCKETS. Final Report, June 1, 1959 to April 30, 1962. (Illinois. Univ., Urbana. Engineering Experiment Station). Contract AF19(604)-5565. 118p.

Research on controlling ionospheric processes by application of radio energy at the gyrofrequency and on developing new methods for ionospheric probing is reported. Supporting laboratory experiments on interaction phenomena in an ionized gas in a steady magnetic field were performed. A rocket carrying a transmitter radiating a strong pulse at about 1.4 Mc was also fired through the ionospheric D and E regions. Modifications to the properties of the medium (collision frequency, rates of various processes, and electron density) from electron heating were detected by observing amplitude modulation upon a sensing signal passed through the region. A preliminary analysis of the results is included. Graphical methods for computing the refractive index and polarization in a magneto ionic medium were developed. Maxwell's equations were solved for the case of an infinitesimal dipole antenna in an anisotropic plasma, and both radiation patterns and near fields were obtained. The rocket experiment showed the usefulness of the electron heating method for studying the D layer. Studies of the ion sheath, plasma heating, and antenna impedance were performed; a theory for the impedance of a short antenna in an anisotropic plasma was developed, tested, and used in designing the rocket experiment apparatus. Results of a laboratory study of the nonlinear interaction of an r-f electromagnetic wave and a plasma are summarized. (D.C.W.)

21900 (D1-82-0181) THE MAGNETOSPHERIC WAVE EQUATION IN DIPOLAR COORDINATES. Mathematical Note No. 259. William C. Hoffman (Boeing Scientific Research Labs., Seattle). June 1962. 17p. (AD-282401)

Dipolar coordinates $\alpha = r/\sin^2\theta$, $\beta = \cos\theta/r^2$, $\varphi = \varphi$, first introduced by A. Dragt in his treatment of hydromagnetic waves in the Van Allen belts, are applied to the vector wave equation for the electric field in an inhomogeneous magneto-ionic medium. For slowly varying media in which magnetic gradients dominate polarization charge gradients, the vector wave equation may be approximated by a system of uncoupled scalar wave equations. The latter reduce to a system of second order ordinary linear differential equations at large distances. The latter are then solved in the WKB approximation. (auth)

21901 THE RADIOACTIVITY OF MINERAL WATERS AND NATURAL GASES OF COVASNA. L. Balogh, B. Barabás, and E. Szabó. Acad. Rep. Populare Romine, Filiala Iasi, Studii Cercetari Stiint., Fiz. Stiinte Tehn., 12: 23-30(1961). (In Rumanian)

The Rn and Ra content of 13 mineral water sources of Covasna were determined. Each of the waters had a different chemical composition. The values obtained were small, with the maximum value being 0.266 mμC/l for Rn and 1.97×10^{-12} g/l for Ra. The Rn concentration of 7 gas sources, of which 4 were noxious, was determined. The Rn concentration of the noxious gases varies between 0.224 and 0.357 mμC/l. By using a G-M counter or a scintillation counter, the β and α radiation level in the gas of the central bath was measured. The number of pulses caused by β and γ radiation reaches 650/min without taking the background into consideration. It was established that the radioactive aerosols formed by Rn decay are adsorbed in great quantity on the skin and clothing of visitors to the gas source. Complete deactivation of the clothing requires several hours. The ratio between positive and negative aerosol ions at the gas source is displaced toward the negative ions. It is claimed that aerosol ionization of the gas sources is an important therapeutic factor. (tr-auth)

21902 THE METEOROLOGICAL CONDITIONS AND THE PROPAGATION OF THE RADIOACTIVE CLOUDS FROM NUCLEAR TEST EXPLOSIONS IN THE SAHARA. V. Mageru, D. Blănariu, and V. Chiriac (Section of Physics Research, Jassy and Regional Hydrometeorologic Service, Jassy). Acad. Rep. Populare Romine, Filiala Iasi, Studii Cercetari Stiint., Fiz. Stiinte Tehn., 12: 35-44(1961). (In Rumanian)

A meteorological study of the air mass circulation and the general weather conditions in the Mediterranean area after the French nuclear explosions in 1960 is reported. For the first explosion, February 13, the meteorological conditions favored the transport of secondary radioactive clouds to the central and eastern regions of Europe before the arrival of the primary ones which encircled the earth in two weeks. After the second explosion, April 1, neither the primary nor the secondary radioactive clouds arrived at Jassy because of the atmospheric conditions in the Mediterranean area. For the third test explosion, December 26, the weather conditions were again favorable for the penetration of some secondary radioactive clouds into the eastern regions of Romania. They were detected at Jassy in the samples collected January 1 and 5, 1961. As a general conclusion, the great importance of meteorological factors on the propagation of radiocontaminants through the atmosphere is indicated. (auth)

21903 THE NATURAL RADIOACTIVITY OF RAIN WATER. Dragoş Blănariu. Acad. Rep. Populare Romine, Filiala Iasi, Studii Cercetari Stiint., Fiz. Stiinte Tehn., 12: 191-8(1961). (In Rumanian)

The natural radioactivity of rain at Jassy in the summer of 1961 was investigated. The samples were always collected within 10 min. and then a fixed quantity of the liquid

was evaporated to dryness. The β activity of RaB and RaC was measured with a thin-window G-M counter. The specific activity of the 29 samples measured varied between 0.88×10^{-11} and 10.11×10^{-11} C/ml, with a mean value of 4.02×10^{-11} C/ml. The effective half life of the activity was 25 to 36 minutes. It was found that the specific activity of rain is inversely proportional to their intensity (as expressed in ml/cm^2/min). During rainfall there was no systematic variation in specific activity; this indicates that the main raindrop activation mechanism occurs in the cloud system. (auth)

21904 MICROCHEMICAL METHOD FOR THE QUANTIFICATION OF C^{14}. Rafael Molina Berbeyer (Universidad Nacional Autónoma, [Villa Obregon,] Mexico). Anales Inst. Geofis. UNAM, Mex., 7: 15-31(1961). (In Spanish)

A microchemical method, developed at the Geochemical and Geochronological Laboratory of the Institute of Geophysics, U.N.A.M., for the quantification of C^{14} for age determination in small quantities of samples at low cost is described here. This method is based on a previous calculation of disintegrations per unit of time per gram of C^{14} on inorganic or organic samples of zero years taken at sites from which the problem sample was collected. Samples from geological and archaeological sites are treated with hydrochloric acid and washed with distilled water to obtain samples enriched with organic matter. These samples are then manipulated through a vacuum tube, where they are exposed to the alternate action of heat and oxygen and finally precipitated, washed and filtered. Then a slow combustion under low pressure, and in the presence of hydrochloric acid is produced by application of heat, followed by purification and washing. Quantification of C^{14} is made in the ionization chamber after oxidation and acidification at a temperature of 160-190°C. Indications are given for the manipulation of the sample in the ionization chamber, in vacuum after which it is taken to the electrometer for application of electric current at low-voltage. Calculations are made for graphic records taken by the electrometer and adjustments and corrections are introduced to arrive at the final reading of age in the problem sample. (auth)

21905 CONDITIONS OF FORMATION AND CLASSIFICATION OF EXOGENOUS URANIUM DEPOSITS. V. I. Danchev. At. Energ. (USSR), 14: 296-308(Mar. 1963). (In Russian)

In view of the increasing importance of exogenous U deposits, their classification attracted great interest. American and Canadian geologists made a detailed study of the rocks from the Colorado Plateau and Canada, using the surrounding formations as the basis of their classification. Ya. D. Gotman divided the exogenous U deposits into sedimentary rocks of oceanic, lake water, or marsh water origin. V. S. Domarev, who also took the endogenous and metamorphic rocks into consideration, divided the exogenous ones into weathered and sedimentary deposits. Similar classification schemes, developed by V. G. Melkov, L. Ch. Pukhal'skiĭ, A. G. Betekhtin, D. Ya. Surazhckiĭ, V. N. Kotlyar, and A. A. Yakzhin, are given. The following classification is proposed on the basis of the conditions of formation and the composition of the surrounding rocks: weathered, sedimentary-hydrogenous, sedimentary, and sedimentary-metamorphic rocks; each of these groups is further subdivided. The epigenic redistribution is considered as one of the stages of the formation process. This approach is expected to be helpful in the correct evaluation of all exogenous rocks, possibly contributing to the discovery of new deposits. (TTT)

21906 METHOD OF MEASUREMENT OF ELECTRON ENERGIES AND OTHER DATA FROM SPECTROGRAMS OF V.L.F. EMISSIONS. R. L. Dowden (Univ. of Tasmania, Hobart). Australian J. Phys., 15: 490-503(Dec. 1962).

It was shown that the detailed frequency-time shape of discrete very low frequency emissions from the exosphere can be closely fitted on the electron-cyclotron theory by suitably choosing the electron parameters. Additional support for the theory was since obtained in the verification of its prediction. It is shown here that the fitting process can be reversed so that these parameters can be deduced from the observed spectrograms. These are: the energy and helical pitch of the emitting electrons, the field line that guides them, the instant of their passing through the equatorial plane, and the electron density of the medium. Nomograms are given allowing calculation of these with occasional use of a slide rule and simple arithmetic. (auth)

21907 DETERMINATION OF THE SPATIAL GROUP OF URANIUM MINERALS. Y. Gobillon and M. van Meerssche (Universitè, Louvain, Belg.). Bull. Classe Sci., Acad. Roy. Belg., (5) 48: 737-41(1962). (In French)

The probability distribution of x-ray intensities of uranium minerals is altered by the presence of uranium atoms. These atoms affect the statistical tests that are used to distinguish centric from acentric structures. If the positions of the heavy atoms are known (from the Patterson map), distribution curves can be calculated for centric structures (Collin). Collin's method was applied to the group determination of the three uranium minerals: sklodowskite, jachimovite, and kasolite. (auth)

21908 CONFIRMATION OF THE STRUCTURE OF SKLODOWSKITE. A.-M. Huynen and M. van Meerssche (Universitè, Louvain, Belg.). Bull. Classe Sci., Acad. Roy. Belg., (5) 48: 742-50(1962). (In French)

A new determination of the major structural lines of sklodowskite confirm the observations by Mokeeva. Nuclear magnetic resonance measurements indicate rapid orientation changes of water molecules. (tr-auth)

21909 STRUCTURE OF DUMONTITES. J. Piret-Meunier, A. Léonard, and M. van Meerssche (Universitè, Louvain, Belg.). Bull Classe Sci., Acad. Roy. Belg., (5) 48: 751-60(1962). (In French)

Dumontite $Pb_2(UO_2)_3(PO_4)_2(OH)_4 \cdot 3H_2O$ is monoclinic. The parameters are a = 8.16, b = 16.73, c = 7.02 Å, and $\beta = 110°$, with the spatial group $P2_1/m$. Z = 2. The structure is formed of foils of uranyl orthophosphate $[(UO_2)_3(PO_4)_2(OH)_2]_n^{-2n}$ parallel to (100) and bound together by Pb^{2+} ions. The uranium occupies two different sites with the coordinates 7 and 8. (tr-auth)

21910 TECHNICAL PHOTOGRAPHY OF SURFACE MOTION. B. Carder, J. Hefferman, and D. Barnes (Edgerton, Germeshausen, and Grier, Inc., Las Vegas, Nev.). Bull. Seismol. Soc. Am., 52: 1007-16(Dec. 1962).

Photographic measurements of the earth-surface displacement were made on the GNOME event, an underground nuclear detonation near Carlsbad, New Mexico, November 1961. One long range and three short range photo stations were used to provide complementary coverage. Motionless inertia weights were measured against graduated targets rigidly anchored to the surface. The experiment is described in detail including target/weight arrangement, camera specifications, and photo station locations in relation to Surface Zero. Analysis of results from 6 films from

close-in stations and one film from the long range station are reported. The peak displacement measured was slightly greater than six feet at a location 106 feet from surface zero. (auth)

21911 CRUSTAL STRUCTURE IN EASTERN NEW MEXICO INTERPRETED FROM THE GNOME EXPLOSION. S. W. Stewart and L. C. Pakiser (Geological Survey, Denver). Bull. Seismol. Soc. Am., 52: 1017-30(Dec. 1962).

The GNOME underground nuclear explosion was recorded at 11 locations ranging from 31 to 431 km north of ground zero near Carlsbad, New Mexico. The seismograms are characterized by the arrival of many phases within a few seconds of the first arrivals. Interpretation of the first arrivals and the more prominent later arrivals indicates that the earth's crust is about 50 km thick in eastern New Mexico. Several arrivals were tentatively identified as reflections from crustal layers and from the base of the crust. A prominent later arrival was identified as a mantle shear phase with a velocity of 4.45 km/sec. (auth)

21912 A REINTERPRETATION OF PHASE VELOCITY DATA BASED ON THE GNOME TRAVEL TIME CURVES. Stewart W. Smith (California Inst. of Tech., Pasadena). Bull. Seismol. Soc. Am., 52: 1031-5(Dec. 1962).

Significant lateral variations in upper mantle velocities across the western U. S. were observed in the GNOME experiment. This makes necessary a reinterpretation of crustal thickness measurements made with the assumption that velocities in the various layers of the crust remain constant while their thickness changes. Four examples of previous work were reinterpreted. The crust is thinner (30 km) in the Basin and Range Province and thicker (55 km) under the Rocky Mountains than indicated by previous interpretations. (auth)

21913 REGIONAL VARIATIONS IN Pn VELOCITY AND THEIR EFFECT ON THE LOCATION OF EPICENTERS. Eugene Herrin and James Taggart (Southern Methodist Univ., Dallas). Bull. Seismol. Soc. Am., 52: 1037-46(Dec. 1962).

Evidence from recent earthquakes and explosions is presented showing substantial regional variations in the velocity of Pn in the United States. These variations have a significant effect on the location of epicenters by the least-squares method. A contour map of Pn velocity in the United States is included. A new method for computer location of epicenters is described, and is shown to decrease the error of location for events in the western United States by as much as an order of magnitude. (auth)

21914 GROUND EFFECTS FROM THE GNOME AND LOGAN EXPLOSIONS. D. S. Carder (U. S. Coast and Geodetic Survey, Washington, D. C.). Bull. Seismol. Soc. Am., 52: 1047-56(Dec. 1962).

Seismic waves resulting from a low yield nuclear detonation 1200 feet deep in a salt bed near Carlsbad, New Mexico, were measured by strong-motion seismographs operated by the Coast and Geodetic Survey on the surface in the distance range from 0.5 to 8.8 miles and underground in a potash mine 8.7 to 11.2 miles distant. In addition, many temporary and permanent seismographs were operated by the Coast and Geodetic Survey and other organizations on a continent-wide and a world-wide basis. Ground particle accelerations exceeded those from the Logan shot, a like detonation in tuff, by a factor of about 4, and accelerations underground in the salt bed were about half those on the nearby surface. There was no evidence of damaging accelerations in nearby commercial operations or dwellings. Nearby transient ground particle displacements were about the same as those from the LOGAN shot, except that the frequencies were higher. Attenuation with distance across the plains to the east was relatively low as compared with similar effects in the mountain and plateau area toward the west. Upper mantle velocities likewise were higher toward the east, 8.3 to 8.4 km/sec, as compared with 7.8 to 8.1 km/sec toward the north, west, and northwest. The estimated magnitude of the GNOME shot was from 4.5 to 5.0, depending on the choice of data. (auth)

21915 TRAVEL TIMES AND AMPLITUDES OF PRINCIPAL BODY PHASES RECORDED FROM GNOME. Carl Romney (Air Force Technical Applications Center, Washington, D. C.), Billy G. Brooks, Robert H. Mansfield, Dean S. Carder, James N. Jordan, and David W. Gordon. Bull. Seismol. Soc. Am., 52: 1057-74(Dec. 1962).

GNOME, an underground nuclear explosion in salt near Carlsbad, New Mexico, produced seismic waves that were recorded widely throughout the United States and at a few foreign stations. The travel times of P were strongly dependent on the path of propagation, and were as much as 12 seconds earlier in the eastern United States than at equivalent distances in the western part of the United States. At the few stations more distant than 25°, P was about 2 seconds earlier than predicted by the Jeffreys-Bullen table for surface focus. Amplitudes of Pn were similarly dependent upon the path of propagation; although the measurements showed great scatter, amplitudes to the east were generally larger than those to the west. Pn travel time and amplitude anomalies suggest a systematic relation to crustal thickness. There is evidence from the difference in the speeds and attenuation rates that Lg and $\bar{P}$ are not transmitted along analogous paths through the crust. Short period body waves were two or three times larger than expected from an explosion of the same energy in tuff at the Nevada Test Site. Surface waves, however, were relatively weak compared with explosions of similar yield in tuff. (auth)

21916 MINERALS OF THE BRITHOLITE GROUP. I. I. Kupriyanova and G. A. Sidorenko. Dokl. Akad. Nauk SSSR, 148: 912-15(Feb. 1, 1963). (In Russian)

Literature data were collected and studies were made on a series of rare earth phosphate- and borosilicates from all over the USSR. The type formula of the britholites is $AI_4AII_6(B_6O_{26}) \cdot (F, OH, O)_2 \cdot nH_2O$, where AI is Ca, Al, Fe; AII is rare earths, Th; B is Si, P, B, Be, Al. Group A, in which the cation varies, contains large amounts of Ca and rare earths, in most cases in the ratio 4/6, and varying amounts of Al and Th. The Al may be in either cationic or anionic form. The principal element in group B is silicon, and the minerals are classified into subgroups based on the proportions of the B group elements present. Results of x-ray spectra, chromatographic, and chemical determinations show a complex rare earth distribution. The diversity of the Ce group distribution is explained by the fact that an alkaline medium is favorable for formation, and the more alkaline lanthanides are more active. The chemical composition affects the cell dimensions; e. g., the mineral with the highest silicon content has the largest cell dimensions, and the minerals with the highest boron content, the smallest. Optical and other properties also vary. The specific gravity varies with the water content. Tables of compositions and properties of a dozen minerals are given. (TTT)

21917 ISOTOPIC COMPOSITION OF URANIUM AND THORIUM IN THE ZONE OF HYPERGENESIS. INVESTIGATION OF FOSSIL BONES, SOIL AND SHELLS OF MOLLUSKS. V. V. Cherdyntsev, I. V. Kazachevskii, and

E. A. Kuzmina (Geological Inst., Moscow). Geokhimiya, No. 3, 254-65(1963). (In Russian)

The ratio of Th isotopes (Io, UX_1, Th^{232}, RdTh) and U isotopes (U^{234} and U^{238}) in natural waters, fossil bones, and soils, as well as in shells of fresh-water mollusks of the Paleolithic site Molodovo and other areas of the Dniester foreland was investigated. In the waters of Molodovo are distinguished waters of neogenic limestones with a low value of $\gamma = U^{234}/^{238} = 10.3 \times 10.5$ and waters of the Paleozoic: $\gamma = 1.34$, apparently feeding the quarternary stratum. The mineralization of fossil bones was realized in the Upper Paleolith by waters with low values and in the Middle Paleolith by waters with high γ-values. Uranium migration was confirmed by the investigation of the radioelement ratios in fossil bones of the sites Molodovo I and Molodovo V. This process apparently did not affect the Mousterian layers of the site Molodovo V, so that the age of the layers, according to Io/UX_1 and γ, equaling 130 thousand years, is near to the truth. The age of the fossil soil of the lower horizon of Molodovo I (end of Riss–Riss-Würm) is more than 260 thousand years. In the shells of fresh-water mollusks an intensive migration of U and Ra isotopes occurs. For example, an exceptional high value RdTh/Th = 12.3 ± 0.9 (activity units) was obtained. (auth)

21918 ABSOLUTE AGE DETERMINATION OF THE SEDIMENTARY ROCKS USING THE LEAD–URANIUM METHOD. A. I. Tugarinov, S. I. Zykov, and E. V. Bibikova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 3, 266-83(1963). (In Russian)

Application of the lead–uranium method is proposed for the absolute age determinations on sedimentary rocks with the aid of authigenic uranium concentrations. Uranium-bearing sulfides and apatites, as well as the micaceous part of sandstones and conglomerates proved to be the most suitable material for such determinations. Results of age determinations with the aid of the method are reported for the Precambrian sedimentary rocks of the Ukraine, the Kursk magnetic anomaly, and the Karelian ASSR. (auth)

21919 CONTRIBUTION TO THE HISTORY OF BERYLLIUM IN PROCESSES OF HIGH-TEMPERATURE POSTMAGMATIC FORMATION OF MINERALS. A. A. Beus, B. P. Sobolev, and Yu. P. Dikov (Inst. of Mineralogy, Geochemistry, Crystal Chemistry of Rare Elements, and Inst. of Cristallography, Moscow). Geokhimiya, No. 3, 297-304(1963). (In Russian)

For the purpose of establishing the peculiarities of Be migration and concentration depending on the evolution of the acidity-alkalinity regime of postmagmatic solutions, a series of experiments was carried out. The stability and mobility of fluoro-complex Be compounds in overcritical and hydrothermal solutions in the pH interval of 1.6 to 12.0 were proved and the process of beryl formation on the front of microcline–perthite albitization at an influence upon it of acid overcritical solutions satured in relation to fluoro–beryllate of Na was modeled. The decay of mobile fluoro-complexes of Be, determining the reaction course of beryl formation is explained by a strong alkalinity increase of solutions in the zone of interaction with microcline. Occurrences of Be replacement by quartz as well as by bertrandite and muscovite were realized experimentally at the influence upon it of fluorine-bearing acid solutions, containing granite components. It was supposed that the crystallization of beryl of a second generation from neutralized solutions of final greysening stages occurs with the participation not only of fluoric, but also carbonaceous forms of Be transport. (auth)

21920 FIELD ALIGNED STRATA IN THE IONIZATION ABOVE THE IONOSPHERIC F_2 LAYER. J. Sayers, P. Rothwell, and J. H. Wager (Univ. of Birmingham, Eng.). Nature, 198: 230-3(Apr. 20, 1963).

Electron density data collected by the satellite Ariel I during 60 orbits from April 30 to July 1, 1962, over a wide range of latitude and longitude were analyzed. There are strong indications that ledges observed on oblique electron density profiles were due to magnetic field aligned ionization strata in the region above the ionospheric F_2 layer. Evidence for magnetic enhancement of the ionization, diurnal variation of the altitude of ledges, the effects of geographic and magnetic latitude and longitude, and stratification of ionization within magnetic shells are discussed. (C.H.)

HEALTH AND SAFETY

Refer also to abstracts 21457, 22689, 22691, 22697, 22699, 22702, 22703, and 22704.

21921 (A/AC.82/G/L.815) LA RETOMBEE RADIOACTIVE A MOL. RAPPORT D'AVANCEMENT—SECOND SEMESTRE 1961. (Radioactive Fallout at Mol. Progress Report for Second Half of 1961). R. Boulenger and G. Koch (Brussels. Centre d'Étude de l'Energie Nucléaire). Oct. 1962. 46p.

The semi-annual progress report on the fallout measured at Mol is presented. The results of measurements on the radioactivity of the air, the total fallout, determination of Sr^{90}, determination of Cs^{137}, and meteorological data are given in tabular form. (J.S.R.)

21922 (AEET/AM-27) ESTIMATES OF BIOSPHERIC CONTAMINATION AND RADIATION DOSE FROM NUCLEAR EXPLOSIONS UP TO APRIL 1962. K. G. Vohra, C. Rangarajan, and Kumari G. Sarada (India. Atomic Energy Establishment, Trombay). 1962. 30p.

The production and dispersion of fission products and induced radioactivity from nuclear weapon tests are discussed. Estimates are given of the important radionuclides released by the tests conducted up to November 1961. The internal and external doses from fission products are calculated on the basis of mean residence times in the stratosphere. The gamma doses calculated from the actual measurements of surface fallout activity at two stations in India, viz., Srinagar and Bombay, are also presented. The estimated contributions of the various test series to the gamma dose at the two stations are discussed. (auth)

21923 (AEET/AM/30) LEVELS OF CERIUM-141 AND CERIUM-144 IN SURFACE FALLOUT SAMPLES COLLECTED AT BOMBAY DURING THE MONSOON MONTHS OF 1962. L. U. Joshi and K. G. Vohra (India. Atomic Energy Establishment, Trombay). 1963. 16p.

Measurements on the levels of cerium-141 and cerium-144 in the surface fallout samples collected at Bombay during June to October 1962 were carried out. The ratios of cerium-141 to cerium-144 activities in these samples were also studied. An increase in the deposition of Ce-144 was observed during the middle of July and middle of September when there were comparatively heavy rains. The increase in Ce-141 activity during the months of August and September was attributed to the arrival of fresh debris. Peaks were also observed in the ratio Ce-141 to Ce-144 during the months of August and September. Chemical procedures used for the separation of cerium from the samples are described. (auth)

21924 (AERE-L-137) LECTURE NOTES IN OCCUPATIONAL HYGIENE. R. J. Sherwood (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 59p.

The role of industrial hygiene in the atomic energy industry is defined. Topics discussed include the maintenance of desirable working conditions and the examination of personnel to find whether illness or discomfort is caused by working conditions and to assess the severity of any radiation exposure. (C.H.)

21925 (AWRE-E-6/63) THE GAMMA DOSE-RATE ABOVE AN INFINITE PLANE SOURCE. D. A. Holme and K. Stewart (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). May 1963. 18p.

Calculations giving the relations between the exposure radiation dose-rate and the energy of the emitted γ radiation at selected heights above a plane area of contamination are summarized. The dose-rates above finite plane circular and plume type sources are also examined. Dose rates and gamma absorption and scattering coefficients in air are included. (auth)

21926 (CEX-58.4.8) AERORADIOACTIVITY SURVEY AND AREAL GEOLOGY OF THE GEORGIA NUCLEAR LABORATORY AREA, NORTHERN GEORGIA (ARMS-I). Jules A. MacKallor (Geological Survey, Washington, D. C. and Division of Biology and Medicine, AEC). Jan. 1962. 36p.

An airborne gamma-radioactivity survey of about 7000 square miles around the Georgia Nuclear Laboratory (GNL) in Dawson County, Ga., was made by the U. S. Geological Survey in cooperation with the Division of Biology and Medicine, U. S. Atomic Energy Commission. The project was flown perpendicular to the regional strike at a nominal elevation of 500 ft above the ground with a flight-line spacing of 1 mile. Radioactivity contacts shown on a 1:250,000 map delineate areas of similar radioactivity, which, in general, trend northeast, parallel to the geologic strike. Many, but not all, formations correlate closely with radioactivity units. Changes of radioactivity within some formations may indicate facies changes. In the GNL area the Cartersville fault, which closely coincides with a prominent radioactivity contact, separates the Valley and Ridge physiographic province from the Piedmont to the east. Within the Valley and Ridge province bedrock consists of sedimentary rocks of Paleozoic age; the radioactivity is from 300 to 900 counts per second (cps). Areas of limestone and dolomite are characterized by radioactivity lows, usually less than 500 cps. Most areas of shale have a radioactivity of 600 to 900 cps. Bedrock in the Piedmont consists mainly of igneous and metamorphic rocks of Precambrian and Palezoic ages, and the radioactivity ranges from about 250 to 2000 cps. The least radioactive rocks (250 to 500 cps) are hornblende gneiss, dioritic injection gneiss, and some of the granitic gneiss. The most radioactive rock is the augen gneiss in Bartow and Cherokee Counties (1000 to 2000 cps). Some of the granitic gneiss, biotite gneiss and schist, and the Talladega Slate have a radioactivity of slightly more than 1000 cps. Composite samples of surficial material were collected from sites directly under the flight path of the aircraft. After analysis for equivalent uranium based upon the number of counts recorded by geiger tubes, the samples were stored for future reference. The equivalent uranium was plotted against cps obtained from the aerial surveying. From 600 cps, which corresponds to slightly more than 0.001 percent equivalent uranium, to 1600 cps, each 200-cps increase corresponds to an increase of almost 0.001 percent equivalent uranium. (auth)

21927 (GAT-R-313) HEALTH AND SAFETY ACTIVITIES REPORT FOR 1962. (Goodyear Atomic Corp., Piketon, Ohio). Feb. 21, 1963. Contract AT(33-2)-1. 58p.

Functions performed by the health and safety groups are outlined. The frequency of incidents pertaining to health,

property damage, and personal injuries during 1962 is reported. (C.H.)

21928 (HW-SA-3030) NUCLEAR PLANT ELECTRICAL MAINTENANCE PROBLEMS, CHEMICAL PROCESSING DEPARTMENT. J. F. Kane (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 26, 1963. Contract AT(45-1)-1350. 8p.

Some maintenance problems encountered by the chemical processing of radioactive materials are described. The problems deal primarily with cranes and electrical motors. Closed circuit television has proved itself useful in certain aspects of the maintenance of equipment and facilities when high radiation levels prohibit access by men. (P.C.H.)

21929 (MND-1963) PRELIMINARY HAZARDS OF CURIUM-242 AUXILIARY POWER SUPPLY. William W. T. Crane (Martin Co., Baltimore). May 1959. Contract [AT(30-1)-2345]. 22p.

A survey of Cm^{242} hazardous properties is presented along with concepts of its use in radioisotopic space vehicle auxiliary power units. (J.R.D.)

21930 (NRL-5800) NUCLEAR SUBMARINE ATMOSPHERES. ANALYSIS AND REMOVAL OF ORGANIC CONTAMINANTS. Interim Report. J. E. Johnson (Naval Research Lab., Washington, D. C.). July 30, 1962. 10p. (AD-285269)

A program of sampling and analysis of the atmospheres of nuclear submarines was carried out for the identification and estimation of organic contaminants. Most of the organic compounds were found to be hydrocarbons. The total hydrocarbon content of submarine atmospheres was initially very high but decreased to very low values in many cases by means of careful control measures. Individual aromatic hydrocarbons were isolated with an estimation of their concentrations. The principal sampling method is based on the exposure of activated carbon on shipboard followed by desorption of the carbon in the laboratory. The most useful means of removing organic contaminants from the submarine atmospheres are combustion by means of a catalyst and adsorption by activated carbon contained in large filter beds. Calculations of the effectiveness of the measures under various conditions of use were made based on typical analytical data. (auth)

21931 (ORNL-TM-569) PORT EVALUATION SURVEYS FOR N. S. SAVANNAH. S. I. Kaplan (Oak Ridge National Lab., Tenn.). Apr. 18, 1963. Contract [W-7405-eng-26]. 12p.

Prior to a visit by the N. S. SAVANNAH to any seaport, a survey of the site is required. The purposes of the survey are to select a berth which will fulfill the nuclear safety requirements under which the ship operates; to prepare an emergency evacuation plan against the contingency of a nuclear incident; and to arrange operational details of the ship's visit with appropriate local authorities. The composition of the port survey team and its mode of operation in U. S. and foreign ports are described. (auth)

21932 (ORO-587(Vol.III)) AN ECOLOGICAL SURVEY OF THE VERTEBRATE FAUNA OF WHITE OAK LAKE AND ENVIRONS. (Tennessee Valley Authority, Norris, Tenn.). [195?]. Contract [AT(40-1)-221]. 208p.

An ecological study was made in 1954 of the vertebrate fauna of White Oak Lake and environs. Radioactive wastes from Oak Ridge National Laboratory were empounded in the Lake. Tissues from a number of animals were analyzed for radioactivity due to fission products. Data are presented for fish and waterfowl. (C.H.)

21933 (TID-18504) VULNERABILITY OF ELECTRIC POWER SYSTEMS TO NUCLEAR WEAPONS. Pilot Study--Region 1. (Defense Electric Power Administration, Washington, D. C.). Oct. 1962. Contract AT(49-5)-2107. 168p.

Development of a methodology to determine the vulnerability of electric power systems to nuclear weapon effects is described. The geographic area selected for the study contained power systems which normally serve the eight states comprising Civil Defense Region 1. (J.R.D.)

21934 (USNRDL-TR-631) FRACTIONATION II. ON DEFINING THE SURFACE DENSITY OF CONTAMINATION. E. C. Freiling and S. C. Rainey (Naval Radiological Defense Lab., San Francisco). Mar. 13, 1963. Contract AT(49-7)-1963. 27p. (AD-402293)

A technical basis for defining surface density of fallout contamination when the contaminating debris is fractionated is presented. Recommendations that the exposure dose rate from fractionated debris be expressed as a contamination surface density multiplied by the sum of three terms are included. The first term is the exposure dose rate contribution of refractorily behaving fission-product nuclides per unit contamination surface density. The second term is a similar quantity for volatile fission-product nuclides. The third term expresses the contribution of the induced activities. (auth)

21935 (NP-tr-996) COMPARATIVE DOSE MEASUREMENTS WITH AND WITHOUT AN IMAGE INTENSIFIER. K. Hohl. Translated by W. G. Stripp (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Radiol. Clin., 31: 247-54(1962). 17p.

Measurements made to determine the surface doses for various groups of examinations such as stomach, esophagus, and colon and the dose-reducing effects of image intensifiers are discussed. (J.R.D.)

21936 THE RATIO OF THE RADIOACTIVITY OF LUMINOUS WATCH FACES AND CORRESPONDING GONAD DOSES. Victor Mageru, Petra Balmus, and Dragoş Blănariu (Medico-Pharmaceutical Inst., Jassy). Acad. Rep. Populare Romine, Filiala Iasi, Studii Cercetari Stiint., Fiz., Stiinte Tehn., 12: 207-14(1961). (In Rumanian)

The β and γ activities of 156 men's and women's watches of different types and brands were measured using a G-M counter and a NaI crystal scintillator. The mean concentration of the radioactive material (in 95% of the cases radium salts and mesothorium) was 0.38μC Ra for a man's watch and 0.12 μC Ra for a woman's watch. In eight watches the concentration of the radioactive material was more than five times the mean value. The irradiation doses to different organs caused by the luminous watches were measured on nine persons with film badges. It was established that the mean dose, for carrying the watch 16 hrs a day, was 8 r/yr and, for the watch with the highest activity, 48.3 r/yr. The mean dose to the head and eyes is 2.5 r/yr. The gonad doses are 6.9 mr/yr for the man's watch of mean activity and 1.5 mr/yr for the woman's watch. All these doses are much lower than the permissible dose; the gonad doses represent 2 to 7% of the gonad dose of the natural background x radiation. A wrist watch presents no somatic or genetic danger. In the cases of watches with maximum activity (more than 2 μC Ra) as the doses are cumulative, they can have a harmful effect if the person is exposed at the same time to supplementary irradiation doses (diagnosis and therapy with x rays or radioisotopes). (tr-auth)

21937 INTERCOMPARISON OF NATIONAL ROENTGEN AND GAMMA RAY EXPOSURE-DOSE STANDARDS. H. O. Wyckoff, A. Allisy, G. H. Aston, G. P. Barnard, W. Huebner, T. Loftus, and G. Taupin (National Bureau of Standards, Washington, D. C.; Laboratoire de Dosimetrie, Paris; Physikalisch-Technische Bundesanstalt, Braunschweig, Ger.; and National Physical Lab., Teddington, Eng.). Acta Radiol., 1: 57-78(Feb. 1963). (In English)

A pair of cavity ionization chambers was circulated to the national laboratories of France, Germany, U. K., and U. S. A. for calibration with roentgen and gamma rays. The difference of their calibrations with a given quality of radiation is taken as a measure of the disagreement of the national standards. The results obtained agree with some earlier direct comparisons to within the expected uncertainty of these measurements or about 0.5 per cent. (auth)

21938 A FURTHER REPORT ON THE RADIOACTIVE CONTAMINATION OF MILK AND MILK PRODUCTS IN JAPAN. DETERMINATION OF STRONTIUM-90 AND CESIUM-137 CONCENTRATIONS IN MILK POWDER IN JAPAN. Tomokichi Tsugo and Yoichiro Omomo (Tokyo Univ.). Agr. Biol. Chem., 27: 188-92(Mar. 1963).

Measurements of Sr^{90} and Cs^{137} concentrations in milk powder were carried out in order to investigate the extent of radioactive contamination of milk in Japan. Whole- and skim milk powders collected from several localities of the whole country every season from 1958 to 1962 were used for radioactivity assay. The results of the experiments show that there is regional variation in Sr^{90} and Cs^{137} concentrations and Cs^{137} $\mu\mu$C/Sr^{90} $\mu\mu$C ratio in milk powder produced in Japan is higher than that of other countries. (auth)

21939 RADIOACTIVE CONTAMINATION OF THE AIR ABOVE THE INDIAN AND PACIFIC OCEANS DURING 1959-60. V. N. Lavrenchik, G. N. Sofiev, and V. M. Shubko. At. Energ. (USSR), 14: 309-13(Mar. 1963). (In Russian)

The geographic distribution of the artificial radioactive contamination of the air above the western portion of the Pacific and of the northern portion of the Indian Ocean was measured during the October 6, 1959–April 28, 1960 cruise of the research ship "Vityaz." It was expected that reliable data would be obtained from measurements of the spreading of air activity over the water because of the great thermal stability of the air masses in those areas. An air filtering device with a flow rate of about 3000 m^3/hr of air was used to collect the samples for the determination of the air activity. The filters were changed every 1 or 2 days. The $\beta + \gamma$ activity of the material collected was determined after incineration; in addition, radiochemical measurements were also carried out. The results indicated that the radioactivity of the aerosols varies only slightly with the longitude but strongly with the latitude. The highest activity was found at 35° North latitude, at the periphery of the Northern Pacific high-pressure zone, and at 25° South latitude, corresponding to the high-pressure area of the Southern Indian Ocean. From these data it was concluded that the distribution of the activity is due to the meridianal circulation. The scheme proposed by G. Dobson (Proc. Roy. Soc. A236: 187 (1956)), according to which the activity from the stratosphere falls out in the region of the 60° latitude, was corrected by assuming on the basis of meteorological considerations that a jet stream is formed from the stratosphere near 30°. (TTT)

21940 SHIFTING OF THE RADIOACTIVE EQUILIBRIUM BETWEEN STRONTIUM-90 AND YTTRIUM-90 IN LAKE WATERS. G. A. Sereda and F. Ya. Robinskii. At. Energ. (USSR), 14: 326-7(Mar. 1963). (In Russian)

Migration of artificial radioactive elements in water is strongly affected by migration phenomena. The radioactive equilibrium between Sr^{90} and Y^{90} which is established in 16 to 18 days may be disturbed by the preferential absorption of Y^{90} by the bottom layer of lakes; the existence of true Y^{90} solutions in lake waters with a pH > 9.5 is not very probable. Therefore, the Sr^{90}/Y^{90} equilibrium was studied in eutrophic and dystrophic lake waters. The shift of the equilibrium was determined on the basis of the ratio $P = (Y_{actual})/(Y_{equil.})$, determining the $Y^{90}_{equil.}$ from the Sr content of the water and the value of Y^{90}_{actual} by standard radiochemical methods. It was found that the Y^{90} concentration was smaller in every case than the true equilibrium value; in swampy water the Y^{90} was nearly completely absent. The results also indicated that the velocity of the removal of Y^{90} from the water of a lake increases with the decrease of its depth. (TTT)

21941 HAZARDS OF RADIATION: REPORT BY THE COMMITTEE ON PUBLIC HEALTH OF THE NEW YORK ACADEMY OF MEDICINE. Arthur V. Greeley, Conrad Berens, Jack Budowsky, et al. Bull. N. Y. Acad. Med., 38: 440-2(June 1962).

Evidence was found in a recent survey of medical and dental x-ray apparatus that carelessness in maintenance of equipment, in its operation, in observing proper precautions in procedure have led to unnecessary patient exposure in New York City. Inspection of equipment revealed that a substantial proportion of it was out-dated and often poorly housed. Needless exposure of the patient because of inadequate beam limitation was also noted. It was found that radiation from medical and dental sources exceeded that from fallout. Of radiographic units inspected by the New York City Health Department, 70% did not provide for the shielding of patients' gonads during the taking of chest roentgenograms. Hence, each patient's gonads were being subjected to from 50 to 100 times the exposure necessary to take a good chest film; with a combination of inadequate shielding and poor technic, the exposure in some instances was from 200 to 500 times more than was necessary, though the average was about 100. Chest fluoroscopy exposed the patient to several roentgens while a roentgenogram could be obtained with only 0.05 r. It was found that many nonradiological physicians and dentists operating x-ray equipment were unaware of the recommendations of the National Committee on Radiation Protection and Measurements. Seven recommendations are proposed for overcoming apprehension in the public mind, deterrent to necessary x-ray examinations. (TCO)

21942 PREPARATION FOR PSYCHOLOGICAL ASPECTS OF NUCLEAR DISASTER. Morgan Martin (Dept. of National Health and Welfare, Ont.). Can. Med. Assoc. J., 87: 1384-6(Dec. 29, 1962).

Psychic reactions of human individuals and populations subjected to catastrophes are outlined, and ways are suggested for dealing with them at various phases of a national emergency. Two myths about disaster have been dispelled by recent research. First, the disaster-struck population is not completely dazed, dependent, and helpless, and second, there is relatively little panic and looting. In a disaster there are 6 special needs of psychological importance: mothering, group formation, special leadership, traffic control, case registry, and communication of adequate information. Disaster studies suggest 3 important psychological first-aid measures: keep people in family groups, encourage talking-out, and provide useful tasks. Such measures are more effective if the helper attitude is adopted. Disaster may be analyzed in 3 phases. It is pre-

ceded by warning, ushered in by impact, and followed first by recoil and then by a recovery phase. Studies of the warning phase show the great need for the individual and group to have and to practice a definite plan of action. Lack of definite preparation causes anxiety, which is in addition to that arising from the knowledge of imminent nuclear attack. The best preparation for adequate behavior in nuclear disaster is education and practice. (H.H.D.)

21943 STRONTIUM-89 AND STRONTIUM-90 LEVELS IN BREAST MILK AND IN MINERAL-SUPPLEMENT PREPARATIONS. Anita A. Jarvis, John R. Brown, and Bella Tiefenbach (Univ. of Toronto). Can. Med. Assoc. J., 88: 136-9(Jan. 19, 1963).

Samples of human milk obtained before and after the resumption of nuclear weapons testing in 1961 were analyzed for Sr^{89}, Sr^{90}, and strontium units (S.U.) ($\mu\mu$C Sr/g Ca) content. The average values of S.U.^{90} were 1.78 in human milk. The Sr^{90} activity from June to October 1961 was 0.366 $\mu\mu$C/l milk, and the mean S.U.^{90} level was 1.40. From November 1961 to February 1962 the values were 0.599 $\mu\mu$C/l and 2.29. Sr^{89} was not detectable in the milk until November 1961; the average concentration from November 1961 to February 1962 was 7.87 $\mu\mu$C/l and the levels of S.U.^{89} averaged 31.74. The average S.U.^{90} levels in cows' milk in Canada and the United States were almost 5 times those found in human milk. In addition, Sr^{89} (as an index of fresh fallout) was already measurable in cows' milk in September; in human milk, it became detectable only in the November 1961 samples, indicating a 2-month lag period. The assayed mineral-supplement products, given to pregnant and lactating women, were generally low in S.U.^{90} levels. The Ca, Sr^{90}, and S.U.^{90} values found in the mineral-supplement products are given. The average S.U.^{90} value was 1.59, which is $\sim 1/5$ the levels reported for cows' milk. Of the 21 samples tested, only 3 samples had S.U.^{90} levels greater than 2, and only 1 sample approached the average S.U.^{90} value of 7.82 measured in cows' milk in Canada. It was concluded that the human female, on a dairy food diet, should secrete milk containing $\sim 1/10$ of the S.U.^{90} levels found in cows' milk. It is assumed that the average dietary level of S.U.^{90} during the period tested was ~11 to 13 S.U.^{90}. The mean Sr^{90}/Ca ratio of 178 found in human milk, therefore, represents an observed ratio milk-diet ratio of ~0.14 to 0.16. (TCO)

21944 CONSIDERATIONS OF THE ACTUAL HAZARD OF RADIODIAGNOSTIC AND RADIOTHERAPEUTIC PROCEDURES. V. Bukiet. Concours Med., 84: 2261-5(Apr. 1962).

21945 EXPANDING USE OF IONIZING RADIATION: ITS HAZARDS AND CONTROL. Hanson Blatz (Office of Radiation Control, New York). Ind. Hyg. Rev., 5: 5-10 (May 1962).

The role of public health officials in protecting the public, particularly urban populations, against radiation is discussed. Aside from accidents, the health hazards of radiation exposure associated with industrial uses of radioactive materials are classified by: direct exposure of individuals who must handle and use radiation-emitting materials during the course of manufacture, storage, transportation, and use; exposure of workers to trace amounts of radioactive materials in their environment, to the extent that they might inhale or ingest significant quantities, which then would be deposited within their bodies; and release of radioactive waste materials either accidentally or deliberately to the extent that they enter air, drinking water, and foods in significant quantities. Restrictions have been placed on the movement of motor vehicles carrying radioactive materials. For maintenance of a healthy radiation safety program, 3 objectives are proposed: careful planning for every operation in order to reduce to a minimum the risk that any individual will become severely overexposed to radiation; maintenance of a respect for radiation hazards and exertion of an effort to keep well within the maximum permissible dose limits, and exertion of extreme efforts to avoid excessive radioactive contamination of the environment by the careful monitoring and control of airborne effluents as well as of any materials released into the ground. (TCO)

21946 RADIATION PROTECTION MEASUREMENTS IN THE USE OF TELETHERAPEUTIC COBALT APPARATUS. Tamas Biro, Laszlo Bozoky, Arpad Veres, and Ferenc Vandor. Magy. Radiol., 15: 43-8(Jan. 1963).

Measurements were made to determine the radiation received by physicians, technicians, patients, and others occupied in the vicinity of a cobalt machine. The measuring techniques are described. The gamma radiation received by the workers was found to be below the natural background radiation and the protection of the patient and environment was also found to be satisfactory. (auth)

21947 ^{90}Sr CONTENT OF INLAND WATERS IN JAPAN. Takahisa Hanya and Tadashi Araki (Tokyo Metropolitan Univ.). Nippon Kagaku Zasshi, 84: 124-7 (1963). (In Japanese)

The investigation was carried out to clarify the distribution and behavior of Sr^{90} in inland waters. Thirty-seven samples were taken from various points in Japan. Sr^{90} in water is collected with cation exchange resin. Eluted by passing hydrochloric acid, it is separated as carbonate in the presence of strontium carrier. Sr^{90} activity is estimated by counting β-activity of Y^{90} present in equilibrium with it. It is concluded that (a) the concentration of Sr^{90} in inland water increases in the order of ground water (0.00$\mu\mu$C/l) river water (0.02 to 0.22$\mu\mu$C/l) and lake water (0.09 to 0.63$\mu\mu$C/l), (b) the Sr^{90} concentration in water has no connection with stable strontium and calcium concentrations in water, and (c) the annual total amount of outflow of Sr^{90} through the rivers to the ocean is approximately equivalent to 0.5 to 1% of the total cumulative amount of Sr^{90} in June 1960, and to 3 to 7% of its annual deposition during the period 1959 to 1960 in Japan. (auth)

21948 FIRE DETECTION IN RADIOACTIVE FILTER BANKS. R. W. Walker (Dow Chemical Co., Denver). Nucleonics, 21: No. 5, 98(May 1963).

A continuous fire detection system that gives warning and activates protective equipment within seconds is described for use in radioactive filter banks. (C.E.S.)

21949 EXPERIMENTAL STUDY OF PROTECTION WHEN USING RADIATION-CHEMICAL UNITS WITH POWERFUL γ-RADIATION SOURCES. A. Kh. Breger, S. S. Gurvits, L. A. Pozdnyakova, and E. D. Chistov. Radioaktivn. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., 241-3(1961).

On the basis of experimental results obtained in tests on hot cells, the field distribution of dose rates in the mazes of the units are given. The energy of scattered γ radiation was estimated by the method of radiation absorption by Pb filters. 80% of the scattered radiation was found to consist of the soft component with an energy of 0.1 to 0.2 Mev. In the radiation maze, the energy of scattered radiation changes but slightly after the first turn. (Referativnyy zhurnal, Khimiya, No. 22, 1961)

21950 RADIOACTIVE CONTAMINATION OF DRINKING WATER; ITS CONTROL, EVALUATION, AND REMOVAL. E. Schumacher and I. Welker (Universität, Zurich). Vierteljahresschr. Schweiz. Sanitaetsoffiziere, 38: 57-66 (Mar. 1961).

Various aspects of radioactivity from fallout in drinking water supplies are discussed in terms of available data collected after nuclear weapons tests and that extrapolated from hypothetical situations resulting from thermonuclear war. The effects of different kinds of radiation on biological systems are also discussed, and the radionuclides likely to be of concern as contaminants of water, as well as their minimum acceptable concentrations, are considered. Specific examples are cited of the degree and kinds of contamination that would be expected after explosions of various magnitude, and the calculated radioactivities of water supplies at subsequent intervals are provided. Methods for reducing contamination of water supplies from fallout are discussed. It is suggested that modern methods of filtration and adsorption used in water purification would remove 50 to 90% of the radioactivity. (H.H.D.)

21951 THE DISTRIBUTION OF NATURAL RADIOACTIVITY ON THE SIZE SPECTRUM OF NATURAL AEROSOLS. MEASUREMENTS FOR LOADING WITH THORON DECAY PRODUCTS. V. Mohnen and K. Stierstadt (Universität, Munich). Z. Physik, 173: 276-93 (1963). (In German)

The apparatus described allows measurements to be made of the distribution of natural radioactivity on aerosol particles. Careful measures were taken so that the aerosol concentration and its size spectrum were not altered before being examined. To increase the accuracy of the measurements the natural aerosol was charged with thoron decay products. The resulting electric charge-distribution by ion diffusion on dust particles is known, therefore the radii of these particles could be calculated by mobility measurements. By means of the law governing attachment of emanation decay products on dust particles, as derived by Lassen or Wieser and Stierstadt (after Bricard), it is possible to calculate the size spectrum of natural aerosol from the measured activity spectrum. Until now only ion spectra were obtained for the range of size 6×10^{-7} to 10^{-5} cm. With the described apparatus however it is possible to measure the size spectrum of natural aerosol. Among other things can be deduced from these measurements, it was concluded that the natural radioactivity of air is attached to particles of radii from 10^{-6} up to 10^{-5} cm, the main part of the activity being carried by aerosols with radii between 4 and 6×10^{-6} cm. From the calculated aerosol spectrum (r from 6×10^{-7} to 10^{-5} cm) follows a mean particle radius of $r = 2{,}5 \times 10^{-6}$ cm at a particle concentration of 3×10^{4} cm^{-3}. (auth)

21952 ENVIRONMENTAL RADIOACTIVITY. Merril Eisenbud. New York, McGraw-Hill Book Company, Inc., 1963. 435p. $12.50.

Information on the subject of environmental radioactivity is consolidated in a systematic and comprehensive manner. The physical and chemical properties of radioactive substances and fallout, the manner in which they are transported physically through the environment, and the ways in which some of them enter into food supplies, water supplies, and the atmosphere are discussed. Emphasis is placed on sources of environmental radioactivity and factors that influence the transport, deposition, and behavior of radioisotopes in the atmosphere, the soil, and the aquatic environment. Data are included from studies on environmental contamination from accidents, and methods of environmental surveillance are discussed in detail. Mechanisms by which human exposures occur are reviewed. Radiation protection standards and regulatory laws and orders of the U. S. are included. (384 references.) (C.H.)

21953 THE ENERGY SPECTRA AND DOSE RATES OF STRAY X-RADIATION. Robertson James Augustine. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 169p.

For absorbed-dose computation or optimum-shielding determination, it is necessary to know the energy spectrum of stray x radiation. Stray radiation includes scattered, secondary, and leakage radiation. The objective of this investigation is to provide the spectral data on stray x radiation for a variety of experimental conditions. The energy spectra, measured with an x-ray scintillation spectrometer, and percentage roentgen dose rates are presented for the stray radiation from a human-equivalent phantom, from typical radiographic room wall sections, and from the x-ray tube housing. The primary beam spectra are presented also and compared with the stray radiation. Although the most important results of the study are the spectral data, some general conclusions are drawn regarding the quality and quantity of stray radiation. These conclusions indicate the effect of tube voltage, filtration, scatter angle, and wall composition on the spectral distribution and intensity of stray x radiation. In many cases, the quality of the stray radiation is found to be appreciably different than the quality of the primary x-ray beam. (Dissertation Abstr.)

21954 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, VOLUME III, NUMBER 11. (Public Health Service, Washington, D. C.). Nov. 1962. 38p. (RHD-Vol.III, No. 11) $0.50(GPO).

Data are presented on radioactivity in samples of air, precipitation, surface water, drinking water, milk, and other foods collected during 1962. Data are included from a survey on levels of Sr^{90}, Ca, and stable Sr in infant diets from 1959 through 1961 and a survey on dental x-ray machines in San Juan, Puerto Rico in 1961. Environmental levels of radioactivity were measured during August 1962 at various stations throughout the country. Data obtained at the Feed Materials Production Facility, Weldon Springs, Mo., during the first half of 1962 are summarized. Information is included on announced nuclear detonations during October 1962. (C.H.)

21955 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT]. VOLUME IV, NUMBER 4. (Public Health Service, Washington, D. C.). Apr. 1963. 63p. (RHD-Vol.IV, No. 4) $0.50(GPO).

Data are presented on levels of radioactivity in samples of air, water, milk, and other foods, and fallout samples collected during 1961 and 1962. Data are included from a study of stable Ca and Sr in diet and bone, radiation exposure from luminous watch dials, the geographical distribution of Cs^{137} in man as determined by whole-body counting, and a survey of x-ray facilities in Los Angeles. Environmental levels of radioactivity were measured at Bettis Atomic Power Laboratory. Data are included on a reported nuclear detonation of March 1963. (C.H.)

21956 ISOTOPE STEUERN MESSEN REGELN. (Isotope Control, Measurement, Regulation). Lothar Schwaar. Leipzig, VEB Fachbuchverlag, 1962. 259p. 5.50 DM.

The general principles of atomic physics are considered, then the various radiation sources, detectors, measuring

apparatus, and the different methods of measuring radioactive materials are discussed. The uses of radioisotopes in chemistry, heavy industry, metallurgy, machine construction, agriculture, and medicine are described. Radiation burdens and radiation injuries are also considered. Principles of radiation protection are presented. Five tables and 116 pictures and diagrams are included. (M.C.G.)

21957 GAMMA RADIATION DOSAGE-MEASURING GLASSES AND METHOD OF USING. Adli M. Bishay (to U. S. Atomic Energy Commission). U. S. Patent 3,089,957. May 14, 1963.

A dosimeter glass for gamma radiation characterized by a borate base, a substantial amount of bismuth trioxide and a minor amount of either arsenic or antimony trioxides is presented. (AEC)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

21958 (AD-285188) INVESTIGATION AS TO THE MERITS OF IRRADIATION IN INCREASING THE SHELF LIFE OF CEREAL PRODUCTS AT LOW OR HIGH MOISTURE LEVELS. Report No. 11(Final), May 2, 1955–December 31, 1961. Howard E. Bauman (Pillsbury Mills, Inc., Minneapolis). 19p.

White and spice cake mixes and the individual ingredients were irradiated at 50,000 to 1,000,000 reps. Although irradiation produced practically sterile mixes, it did not retard the rate of chemical deterioration and did not increase shelf life. Irradiation was actually detrimental to the baking qualities of the unstored dry mix, flour, sucrose, shortening, and dried egg albumen. (auth)

21959 (ORO-601) RADIATION PASTEURIZATION OF SHRIMP. Final Summary Report for the Period, January–December 1962. A. F. Novak and J. A. Liuzzo (Louisiana State Univ., Baton Rouge). Contract AT(40-1)-2951. 36p.

Radiation processing of shrimp was investigated as a means of extending refrigerated storage life from 15 to 30 days or longer. Doses of Co^{60} γ radiation of 50,000 to 100,000 rads resulted in an increase in the iced storage life of shrimp of from 2 to 7 weeks, as compared to unirradiated controls. The shrimp were judged on odor, general appearance, sweetness, flavor, texture, and results of organoleptic and chemical tests. It was emphasized that the procedures employed for obtaining fresh shrimp, methods of handling and storing, and the time of holding prior to irradiation affect the keeping qualities and that only products of high initial quality can be preserved successfully by radiation processing. (C.H.)

21960 (AEC-tr-5773) RESEARCH IN GAMMA IRRADIATION OF WHEAT FLOUR. A. R. Deschreider. Translated from Conserva (The Hague), 10: No. 6, 115-17 (1961/62). 9p. (Includes original, 3p.).

Irradiation of wheat flour and cereal products with doses of Co^{60} γ radiation between 25 and 150 kilorad resulted in destruction of insect pests in all stages of development. Exposure of flour to doses between 25 and 150 kilorad improved the baking quality of wheat flour, and doses of 500 to 1000 kilorad improved the storage life of unrefrigerated pre-baked or partially-baked packaged products. Results are reported from studies of the chemical effects of γ radiation on the proteins, enzymes, and other constituents of wheat flours. (C.H.)

21961 (AEC-tr-5775) FRACTIONATION OF THE PROTEINS OF LYOPHILIZED WHEAT GLUTEN TREATED WITH GAMMA RAYS. A. R. Deschreider. Translated from Minerva Dietol., 2: 187-9(Oct.-Dec. 1962). 14p. (Includes original, 7p.).

The effects of γ radiation on lyophilized gluten extracted from a flour of winter wheat and an extract of flour of summer wheat were examined after exposure to doses of Co^{60} γ radiation ranging from 50 to 5,000 kilorads. Irradiation was found to affect condensation or polymerization of a part of the albumins in proteins, which was manifest by a decrease of electrophoretic mobility and changes solubility in water, and to effect the formation of protein molecules. Differences in extracts from flour of winter and summer wheat are reported. (C.H.)

21962 (NP-tr-995) THE EFFECT OF X-IRRADIATION ON THE PROCESS OF CO_2 PRODUCTION BY APPLES IN THE COURSE OF DEVELOPMENT. Johannes Wolf. Translated by D. H. Williamson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Flora, 150: 175-8(1961). 9p.

An immediate increase in CO_2 production was observed in apples that were exposed to small doses of x radiation. The response was effected by state of ripeness and storage in the dark at 20°C. The relation of CO_2 production to ripening of apples is discussed. (C.H.)

21963 PRODUCTION AND UTILIZATION OF RADIOISOTOPES. C. G. Osterlundh and L. G. Erwall (AB Atomenergi, Stockholm). Atomwirtschaft, 8: 67-74(Feb. 1963). (In German)

Neutron irradiations have been made in Sweden regularly in the R-1 reactor since 1955. Production of chemically processed material is to be started in 1963. Most of the radioisotopes produced were short-lived ones and were used principally for research with about 20% going to industrial development and applications. The irradiated materials are standardized and an absolute determination of the activity in solutions is made using all available methods to give the highest accuracy. Swedish industry has used radioisotopes for process and quality control and in research and analysis. Typical applications are indicated. (J.S.R.)

21964 RADIOISOTOPE PRODUCTION IN DENMARK. K. Heydorn (Research Establishment, Risø, Roskilde, Denmark). Atomwirtschaft, 8: 93-5(Feb. 1963). (In German)

The development of the radioisotope production facilities at Risö is described. The laboratory can handle activities from less than 1 μC up to more than 100 C. No serious contamination accidents have occurred. The fluxes available range from 10^{12} to 2×10^{14} n/cm^2/sec. Tritium labeling facilities are in operation. Package design studies for transport have resulted in a plywood folding box. (J.S.R.)

21965 THE TECHNICAL APPLICATION OF RADIOISOTOPES IN DENMARK. Erik Somer (Isotopcentralen, Copenhagen). Atomwirtschaft, 8: 96-8(Feb. 1963). (In German)

The pioneer work of Hevesy and his coworkers on activation analysis and isotopic dilution made the introduction of isotope technology into Denmark easier. The foundation of the isotopic center for research on tracer applications is described. The research at the center is concentrated on tracer and radiometric procedures for process studies. Typical examples given of radiometric procedures include porosity control of heavy iron or lead components, control of reinforcing structure in ferro-concrete elements, checking internal bore of tubes, and determination of moisture content of bulk goods. Typical tracer studies are also described. (J.S.R.)

21966 PRODUCTION AND APPLICATION OF RADIOISOTOPES IN NORWAY. U. Been (Institutt for Atomenergi (IFA), Kjeller, Norway). Atomwirtschaft, 8: 133-5 (Feb. 1963). (In German)

There is a regular program of radioisotope production at Kjeller for medical, research, and industrial purposes. About 13,000 consignments have been handled. A program for development and consultation on isotope applications was developed in connection with the production. The principal applications are in the medical and biological area, although important results have been obtained in other sciences and in industry. (tr-auth)

21967 NUCLEONICS AND INDUSTRY. Denis Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). Ind. Electron., 1: No. 1, 18-21(Oct. 1962).

Some of the industrial applications of radiation are described briefly, and two are discussed in more detail: thickness gages and activation analysis (O_2 determination in metals as an example). (D.L.C.)

21968 IODINE-125 MAKES A BETTER LOW-ENERGY GAMMA RADIOGRAPHY SOURCE. Irwin J. Gruverman and J. Kenneth Schivley (Nuclear Science and Engineering Corp., Pittsburgh). Nucleonics, 21: No. 5, 96-7(May 1963).

The properties of iodine-125 that make it suitable as a low-energy gamma radiography source are presented. An exposure device and radiographs made with I^{125} sources are included. (C.E.S.)

21969 THE USE OF RADIOACTIVE ISOTOPES TO FIGHT STATIC ELECTRICITY IN THE RUBBER INDUSTRY. Henryk Ryzko. Prace Inst. Elektrotech., 8: No. 23, 55-64(1960).

The method of removing electrostatic charges, tried out on a belt of rubber-coated fabric moving with the speed of 0.25 to 0.5 m/sec, is described. The belt was charged by means of corona discharge. To remove the charges, 2 Sr^{90} sources with the activity of 15 m C each were used. A diagram of the measuring device is given. At the belt speed of 0.25 to 0.5 m/sec maximum the discharge current amounted to 0.23 μa (with the distance of 1 m between the belt and sources of radiation). The possibility of utilizing Tl^{204} as radiation sources is pointed out. A diagram of the adaptor for the source installation, block diagram of the discharge current measurement, and calculated formulas for determining the required activity of radiation sources are given. (Referativnyy zhurnal, Avtomatika i radioelectronika, No. 12, 1961).

21970 INDUSTRIAL PROCESSING WITH GAMMA RADIATION. Wantage, Berks, Eng., United Kingdom Atomic Energy Authority, 1963. 28p.

A booklet is presented for the purpose of enabling potential users to decide whether radiation processing offers any attractions in their particular circumstances. The advantages, disadvantages, and some industrial applications of gamma radiation are discussed. The design of plants for use of gamma radiation is described with reference to the Package Irradiation Plant at Wantage. The economics of radiation processing are considered. Safety and legislative aspects of irradiation plants are also discussed. Finally, the steps to be taken in investigating further the possible use of radiation processing are summarized. (D.L.C.)

INSTRUMENTS AND INSTRUMENTATION

General and Miscellaneous

Refer also to abstract 21993.

21971 (AD-282306) AGING CHARACTERISTICS OF QUARTZ CRYSTAL RESONATORS. Quarterly Report No. 5, February 15, 1962–May 15, 1962. R. B. Belser and W. H. Hicklin (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract DA-36-039-SC-87407. 46p.

Approximately 70 quartz resonators were continued on storage and measurement, and 94 new units were fabricated. The acquisition of a Rohde and Schwarz frequency synthesizer, after some necessary maintenance, facilitated frequency measurement. The measurement accuracy and resonator stabilities obtained directed attention to oven temperature control and oven design as the principal remaining areas wherein improvements must be made for attainment in this work of maximum resonator stabilities. The problems encountered are associated with large ovens where heat losses, entry recovery, and frequency versus position differences cause significant variations in frequency measurements for a given resonator. In addition, these conditions limit periods in which accurate measurements may be made. Measurements of Q for resonators fabricated, made for the series mode of operation, gave values in the range 100,000 to 300,000. Resonators previously fabricated continued to exhibit excellent stabilities within the limitations of the measurement and temperature control facilities. Mounting of resonators in the HC-27/U glass container is now giving excellent yield (about 90%). Silver plated units did not survive heat requirements for sealing. (auth)

21972 (AD-282398) RESEARCH AND INVESTIGATION ON RADIATION RESISTANT, HIGH TEMPERATURE THERMIONIC CIRCUITRY. Interim Engineering Report No. 5, April 1, 1962–June 30, 1962. Fred J. Schmidt (General Electric Co. Receiving Tube Dept., Owensboro, Ky.). Contract AF33(616)-8096. 146p.

TIMM tube research and development efforts were continued in the areas of electrical and mechanical design, materials evaluation, component fabrication and evaluation, module fabrication and radiation effects studies and evaluation. Triode grid investigation programs were continued with emphasis being placed on improvement of previously used tensioning techniques and the evaluation of new techniques and means to stretch the mesh and to control grid flatness in the finished device. An optical grid transparency measuring instrument was designed, and is currently being used for 100% sorting of grids. Programs are continuing to design a hexagonal mesh grid, equivalent to the 0.004 × 0.040 rectangular mesh, for improved mechanical strength. A TIMM pentode is being developed for improved electrical performance. Design parameters are discussed and desired electrical characteristics and cross section views of the device are presented. (auth)

21973 (HW-74783) INVESTIGATION OF A POWER SPECTRUM ANALYZER FOR USE WITH RANDOM SIGNALS. J. F. Hauer and C. D. Swanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1963. Contract AT(45-1)-1350. 44p.

Results of an investigation and evaluation of a reactor power spectrum analyzer operating on principles of Fourier analysis are discussed. The accuracy and rate of analysis, required operator effort, and equipment stability are discussed. (J.R.D.)

21974 (IDO-16809) A TRANSFER FUNCTION FOR D. C. OPERATIONAL AMPLIFIERS WITH GENERALIZED EXTERNAL NETWORKS. S. R. Gossmann (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 25, 1963. Contract AT(10-1)-205. 16p.

A transfer function for d-c operational amplifiers with generalized input and feed-back networks is derived by application of network theory. This transfer function, more general than others in common use, applies to three and four-terminal networks. It contains, as a special case, the well-known transfer function for d-c operational amplifiers with two-terminal networks. Examples are given. (auth)

21975 (ISS-63/3) SERVIZIO ELETTRONICO. CATALOGO DELLE APPARECCHIATURE ELETTRONICHE STANDARDIZZATE DA E 101 A E 110. (Electronic Service. Circuit Diagrams and Characteristics of Standard Electronic Equipments E 101 to E 110). (Italy. Istituto Superiore di Sanità, Rome). Jan. 4, 1963. 49p.

Circuit diagrams and characteristics of electronic equipment built by the electronic service of the Laboratory of Physics are presented. Since the catalogue is intended to give the experimenter a short account of equipment available off the shelf, specific technical and scientific news is omitted; and bibliographic news is added only in the case of some new circuits. (auth)

21976 (NBL-194) THE MEASUREMENT OF M/E POSITIONS FOR A MASS SPECTROMETER USING A ROTATING COIL GAUSSMETER. Hugh O. Finley and Ralph J. Hemmer (New Brunswick Lab., AEC, N. J.). Apr. 1963. 16p.

A magnetic flux measuring system was converted for the identification of M/e positions in a 6-inch radius, directional focusing, mass spectrometer. The voltage generated by a synchronous motor-driven "rotating coil" placed in the magnetic field of the analyzer section of the mass spectrometer is measured by a potentiometer. This measured voltage is a function of the field strength and may be used to calculate the M/e for a given ion energy and variable magnet current setting. Two methods are used to determine the M/e values. The first method is for fast scanning over a wide M/e range of several hundred mass positions. The second method is for very accurate fractional M/e differences over a small mass range. The system is accurate to within 0.25 mass unit in the high mass range and within a 0.1 mass unit at lower mass positions. The system is very stable and does not require appreciable maintenance. (auth)

21977 (SCTM-71-63(24)) PRECISION TEMPERATURE CONTROL OF AIR AND OIL BATHS. N. L. Hensinger (Sandia Corp., Albuquerque, N. Mex.). Mar. 1963. Contract AT(29-1)-789. 21p.

Precise temperature control of a variety of laboratory air and oil baths was achieved by means of a simple variable-reactance temperature controller. The controller, in combination with a carefully designed air bath,

achieved temperature control to ±0.003°C. In combination with a carefully designed oil circulation system, temperature control to ±0.02°C was achieved in large oil baths. The controller employs one or more heaters carrying a continuous current to compensate for heat losses to the atmosphere, and a second, intermittent current to provide precise temperature control. Both the continuous and control currents are variable over wide ranges to make the control unit readily adaptable to a wide range of cabinets, chambers, and tanks. (auth)

21978 (TID-18545) SODIUM RESISTIVITY METER LOOP. Summary Report, February 1963. (Atomic Power Development Associates, Inc., Detroit). Contract AT(11-1)-865. 10p.

Development of instrumentation for determining the resistivity of sodium is presented. The sodium resistivity loop with circuit modifications to extend the temperature range of operation is evaluated for effects upon accuracy and stability. (C.E.S.)

21979 (TID-18560) FINAL REPORT ON [IMAGE TUBE DESIGN]. G. Francis and W. F. Niklas (Rauland Corp., Chicago). Mar. 19, 1963. Contract AT(11-1)-1058. 26p.

Considerations in image tube design and the design of an actual tube are discussed. Technological considerations (photocathode activation and preparation of the glass envelope and its components) are also described. Results obtained with fifteen tubes and problems encountered with each tube are listed. Remarks on photocathode sensitivity and resolution and suggestions for future work are included. The tube designed and developed shows promise as the first intensifier in a detector chain. The basic electron optical design also has great possibilities. An internally processed cathode has more advantages than the externally processed cathode, and the use of fiber optics as the interstage coupler has advantages over a thin glass membrane. (D.C.W.)

21980 (UCRL-10499) ULTRACENTRIFUGE PHOTOELECTRIC SCANNER, SPLIT-BEAM. Kenneth W. Lamers (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 9, 1962. Contract W-7405-eng-48. 68p.

An electromechanical scanner was developed for displaying optical density changes when a light-absorbing material such as virus, protein, or nucleic acid is sedimenting in the centrifugal field of an ultracentrifuge; that is, a high-speed centrifuge employing an optical system. These materials absorb some of the light transmitted by the optical system, thereby projecting an image that varies in intensity with distance from the center of rotation. This image, which consists of alternate light pulses from a reference and a sample cell, is scanned by a photomultiplier. Subsequent circuitry separates the reference and sample pulses and takes their logarithmic difference. The system, therefore, compensates for non-uniform illumination and other optical imperfections. The logarithmic difference is displayed on a chart recorder, the paper moving in synchronism with the scanner. Optical density (concentration) is thereby displayed as a function of radius. An additional trace simultaneously records the derivative of the density profile. Other modes record the image of each cell before optical correction. An internal calibration feature permits absolute measurement of optical density. (auth)

21981 (AERE-Trans-903) STATIC AND DYNAMIC MAGNETIC FIELD MEASUREMENTS. H. Sima. Translated by D. Loman (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Elektrotech. Z., 14(B): 175-8(1962). 12p.

Instruments and recording apparatus that can be used satisfactorily in combination with Hall probes to measure the magnitude and time variation of static and alternating magnetic fields are discussed. The errors originating in the probes, which are liable to falsify the measurement results, are discussed in detail to give a clear idea of their magnitude and effect. The oscillographic recording of a weak alternating magnetic field is described as an example. (auth)

21982 (NP-tr-994) SCALERS USING TUNNEL DIODES. E. Baldinger, U. Spycher, and R. Bossart. Translated by W. G. Stripp (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Helv. Phys. Acta, 35: 237-40(1962). 6p.

A description is presented concerning the fabrication and performance of scalers using tunnel diodes. (J.R.D.)

21983 SEMICONDUCTOR LOGARITHMIC D.C. AMPLIFIER. M. Y. El-Ibiary (Cairo Univ.). IEEE (Inst. Elec. Electron. Engrs.) Trans. Nucl. Sci., NS-10: No. 2, 21-31 (Apr. 1963).

The logarithmic region of the forward characteristics of p-n silicon junction diodes at low currents is utilized to give accurate logarithmic conversion of current into voltage over a range of eight decades at room temperature. A chopper type d-c amplifier is used to measure the logarithmic voltage without drawing an appreciable current. It consists of a specially developed low-leakage balanced diode chopper, a high-gain a-c amplifier, and a demodulator. The voltage output of the demodulator is fed back to the chopper. Temperature compensation is achieved by a thermistor element in the feedback loop and the resulting thermal drift is less than 0.005 decade per degree centigrade over most of the amplifier range. Many of the available types of diodes were found to exhibit irregular and considerable deviations from accurate logarithmic relationship. (auth)

21984 THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE FERROMAGNETIC EXPLOSIVELY SHOCKED CURRENT PULSE GENERATOR. Jerome H. Johnson (Sandia Corp., Albuquerque, N. Mex.). J. Appl. Phys., 30: Suppl., 241S-3S(Apr. 1959). (SCR-609)

Theories of operation of the ferromagnetic explosively actuated current generator, an approximate theoretical analysis of the effect of variation of the basic circuit and device parameters, and a comparison of theory with experimental results are presented. Theoretical and experimental data are presented and compared for peak current versus circuit load inductance, device load coil turns, and magnetic core width (for a fixed thickness). There is a gratifying similarity between theoretically predicted and experimentally determined data. Guiding criteria are given for an optimum ferromagnetic current pulse generator system. (auth)

21985 A MICROSECOND NUCLEAR RESONANCE PULSE APPARATUS. P. Mansfield and J. G. Powles (London Univ.). J. Sci. Instr., 40: 232-8(May 1963).

A nuclear resonance pulse apparatus is described which is suitable for broad absorption lines as found in solids as compared with previously described equipment only suitable for liquids. The equipment gives a better than 1 μsec 2.5 kv, 20 Mc pulse and reads a 100 μv nuclear signal 4 μsec from the beginning of the pulse. The designs of the modulator, oscillator, receiver, and probe are dis-

cussed in detail. The principal difficulty is in achieving satisfactory pulse cut-off. The problems arising are of general interest. (auth)

21986 A MAGNETIC PROBE FOR PLASMA MEASUREMENT. S. Berglund, S. Westerlund, and S. Svennerstedt (Uppsala Univ.). J. Sci. Instr., 40: 250-2(May 1963).

It is shown that, in the design of magnetic probes for plasma field measurements, attention must be given to the space resolving power of the coils. A technique is described, which, by mechanical means, gives an exact alignment of the individual coils in a multiple probe without any need for further manual adjustment. Integration of the signals by means of transistorized Miller integrators, placed at the probe end of the transmitting cables, gives a good signal-to-noise ratio. The described system has an overall sensitivity of 1 mv G^{-1} at an RC time of 8 msec, and the bandwidth extends to over 2 Mc. (auth)

21987 THE VOLATILIZATION OF HIGH MELTING SOLIDS IN A MASS SPECTROMETER. H. C. Hill and R. I. Reed (Univ. of Glasgow). J. Sci. Instr., 40: 259(May 1963).

An apparatus is described which allows the mass spectrometric analysis of rather involatile materials. Modifications were introduced which facilitate this type of investigation. (auth)

21988 ON ONE POSSIBILITY OF OSCILLOSCOPIC MEASUREMENT OF SHORT TIME INTERVAL AND SHORT PULSES. Ivo Petr (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Rez). Jaderna Energie, 9: 77-80 (1963). (In Czech)

The seldom used oscilloscopic method of millimicrosecond interval measurement using annular or spiral high speed time base is examined. The advantages of this method are compared with those of other oscilloscopic methods utilized more frequently. A rough design of such instrument is given, and some requirements on a special screen tube and on the third radial departing electrode are reported. (auth)

21989 CURRENT-VOLTAGE CHARACTERISTICS OF THE HELIUM FIELD-ION MICROSCOPE. M. J. Southon and D. G. Brandon (Cambridge Univ., Eng.). Phil. Mag., (8), 8: 579-91(Apr. 1963).

The characteristic variation of ion current with applied voltage in a helium field-ion microscope is reported. Current-voltage characteristics were measured as functions of emitter radius, operating temperature, and helium pressure, and also for emitters of various metals. Practical implications of the results are mentioned and the observed behavior is compared with the existing theory of field ionization. Experimental findings support general aspects of the theory but there are several disagreements in detail. In particular the theory fails to account for the observed magnitude of the ion current at high fields and its variation with voltage and emitter radius. (auth)

21990 SPIN-ECHO SPECTROMETER. A. S. Agishev, M. Z. Zinyatov, S. Kh. Kashaev, N. S. Kucheryavenko, and F. M. Samigullin (Kazan Pedagogical Inst., USSR). Pribory i Tekhn. Eksperim., No. 1, 78-83(Jan.-Feb. 1963). (In Russian)

Descriptions are given of a spin-echo spectrometer. The spectrometer is capable of six different methods of operation due to a special programming attachment. Spectrometer parameters permit a wide range of operations including short and long relaxation times (from T_1, $T_2 \sim 20$ μsec to hundreds of seconds and more). (tr-auth)

21991 MEASUREMENTS OF FILM THICKNESS BY RECORDING β SCATTERING. Yu. S. Zaslavskii, G. I. Shor, A. D. Stukin, and E. D. Stukin (All-Union Oil Refining Research Inst., USSR). Pribory i Tekhn. Eksperim., No. 1, 149-52(Jan.-Feb. 1963). (In Russian)

A design is given of an end-window Geiger β counter developed for measuring carbon or varnish deposit formed on lubricated steel surfaces. The device is capable of measuring polyethylene film or metal plating on a metal. (R.V.J.)

21992 CURRENT INTEGRATOR OF AN ELECTRON BEAM. N. G. Afanasev and A. V. Demyanov (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 7: 36-8 (Jan. 1963). (In Ukrainian)

A current integrator is described on the basis of a plant-manufactured native instrument, the "Cactus" microroentgenometer. The instrument is designed for integral measurements of the electron beam current of linear accelerators at 100, 400, and 2,000 Mev, over a range of $10^{-7}-5\times10^{-10}$ amps with an accuracy of 2%. The basic purpose of the instrument consists in the absolute measurement of the primary electron beam, essential for calculating the absolute cross section of the processes of interaction of high energy electrons with matter. (auth)

21993 INVESTIGATION OF PLASMOIDS BY MEANS OF A THERMOCOUPLE. I. I. Demidenko, N. I. Mitina, and V. G. Padalka (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 7: 61-4(Jan. 1963). (In Ukrainian)

A procedure is developed for preparing highly sensitive and low-inertial free bismuth-silver thermocouples by the method of vacuum evaporation. The thermocouple was used to conduct an investigation of plasmoids formed by a Bostick source. The studies were carried out with and without a longitudinal magnetic field. The velocity of the plasmoids is estimated. (auth)

21994 BAKEABLE DIFFERENTIAL MANOMETERS OF THE BOURDON TYPE. A. E. D. Heylen (Queen Mary Coll., London). Vide, 18: 69-71(Jan.-Feb. 1963). (In English and French)

A manometer for use in ultrahigh vacuum systems that need not be disturbed for bake-out is described. The principle used is the detection of a change in capacitance between two parallel-plate disks, one of which acts as a set-zero probe, the other being connected to a sensitive bellows system which responds to a difference in pressure. A diagram of the instrument is presented. The sensitivity of the manometer can be adjusted by varying a potentiometer on the proximity meter and by altering the parallel-plate gap by means of the micrometer. (M.C.G.)

21995 A DOUBLE-FOCUSING MASS SPECTROMETER WITH INHOMOGENEOUS MAGNETIC FIELD AND TOROID CONDENSER. H. W. Wachsmuth and H. Ewald (Technische Hochschule, Munich). Z. Naturforsch., 18a: 389-97(Mar. 1963). (In German)

The principles, construction, and first tests of a magnetic spectrometer consisting of a magnetic sector field between conical pole shoes (n = 0.889) and a toroid condenser are described. A photographic series shows the dependence of the image properties of the spectrometer on the grounding of the deflected voltage. The fulfilling of the double-focusing conditions could be demonstrated. For an object gap of 0.14 mm width the theoretical resolution possibility was 10,000, for the 0.014 mm gap width in the described preliminary experiments a resolution possibility of about 50,000 was found. (tr-auth)

21996 LOW NOISE PREAMPLIFIERS (Engineering Materials). (Oak Ridge National Lab., Tenn.). 5 drawings. (CAPE-896)

These preamplifiers are used with the silicon diode counters, the solid-state detectors, and may be modified to be used with the A1D amplifier (see CAPES-299 and 518) or the double delay line (DD_2) amplifiers (see CAPES-209 and 768). The rise time is 0.1 μsec in Cain 32 positive and 0.16 μsec in Cain 1024 positive. The output is 5 ma. The grounded input noise is approximately 3.7 μv rms on 2 mc band width with 1 μsec delay line clipping. The input noise with a 15 pf detector load is about 50% higher on 2 mc band width and much higher on lower band widths. (F.L.S.)

21997 CRYSTAL-CONTROLLED PULSE GENERATOR (Engineering Materials). (Oak Ridge National Lab., Tenn.). 5 drawings. (CAPE-940)

The device is used in checking calibration and linearity, and in accurately setting the frequency of count-rate meters. The circuit consists of a basic crystal-controlled oscillator, followed by four decade-dividers having scale factors of 2, 4, 6, and 8. Selection of either 30 kc or 100 kc crystals is possible by means of a selector switch. Two other selector switches are in the divider circuit and provide scale factors of 1, 10, 100, 1000, and 10,000 pulse scale factors of 2, 4, 6, and 8. This combination provides 50 spot frequencies between 0.375 cps and 100 kc's with the precision of the crystal oscillator. The pulse shapers that follow the dividers provide 3 different outputs. Two of the outputs are 12 v square waves of 0.8 μsec duration with rise and fall times of 100 nanoseconds. One output is negative, the other is positive. The third output is negative having a 100 nanosecond time and a selection of six fall times ranging from 3 to 300 μsec. This output is from a 100 ohm attenuator with a maximum amplitude of 0.5 v when feeding a 100-ohm terminated line. (F.L.S.)

21998 POWER SUPPLIES FOR ELECTRONIC EQUIPMENT (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). 12 drawings. (CAPE-958)

This package includes power supplies for LASL electronic equipment. There are high-voltage power supplies for photomultipliers, Models 2, 3, 4, and 5. Power supplies are included for the 10 Channel Pulse Height Analyzer, Model 102 (4Y-26522), and the 10 Channel Pulse Height Analyzer (4Y-26551) (see CAPE-10). Power supplies are available for the scaler used with 4Y-26551 and for the Scaler Model 800 (4Y-26140). (F.L.S.)

21999 FLAME PHOTOMETER COOLING AND VENTILATING SYSTEM (Engineering Materials). (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). 1 drawing. (CAPE-970)

The cooling and ventilating system was designed to prevent a health hazard caused by the production of finely divided airborne beryllium oxide particles in the determination of Na and K in Be by flame photometry. The system consists of a sheet metal hood enclosing the top of a flame attachment and a plastic scrubber tower 7 in. in dia. and 21 in. high. The hood and tower are connected by a 2 in. Cu tubing with ¼ in. soft solder coils. A screen diffuser and baffle plates are used for the scrubber action. Samples of exhaust gases leaving the scrubber showed no detectable Be. (F.L.S.)

22000 STABILIZED TRANSISTOR AMPLIFIER. J. B. Noe (to U. S. Atomic Energy Commission). U. S. Patent 3,089,098. May 7, 1963.

A temperature stabilized transistor amplifier having a pair of transistors coupled in cascade relation that are capable of providing amplification through a temperature range of −100°F to 400°F described. The stabilization of the amplifier is attained by coupling a feedback signal taken from the emitter of second transistor at a junction between two serially arranged biasing resistances in the circuit of the emitter of the second transistor to the base of the first transistor. Thus, a change in the emitter current of the second transistor is automatically corrected by the feedback adjustment of the base-emitter potential of the first transistor and by a corresponding change in the base-emitter potential of the second transistor. (AEC)

Radiation Detection

Refer also to abstracts 22665, 22701, and 22782.

22001 (AD-282315) STUDIES RELATED TO THE GASEOUS QUANTUM COUNTER. Technical Note 8. Arthur Lubin (Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.). Sept. 1961. Contracts AF33(616)-7096 and Nonr 1851(40). 31p.

Progress made in investigating the practical limitations to the theoretical potentialities of a gaseous quantum counter that would use selected electronic transitions in certain gases to detect infrared radiation is described. Theory is discussed; the experimental program is outlined; and the results of the physical experiment are given. (auth)

22002 (AERE-R-4244) THE FAST NEUTRON DOSE RESPONSE OF TWO ORGANIC PHOSPHORS AND THEIR POSSIBLE USE FOR DOSIMETRY. M. McN. Wasson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1963. 34p.

Using the results of Monte Carlo calculations on the response of two organic phosphors to fast neutrons, the possibility of using the phosphors for fast neutron dosimetry is examined. The effect on their response of decay time discrimination against γ rays is also considered. Stilbene and de-oxygenated liquid phosphor, Ne 213, are discussed. (auth)

22003 (CEA-2255) COMPTEUR 4 π DE PARTICULES β POUR-LA MESURE ABSOLUE DE L'ACTIVITE DES DETECTEURS. APPLICATION AUX DETECTEURS DE SOUFRE. (A 4π Beta Particle Counter for the Absolute Measurement of Detector Activity. Application to Sulfur Detectors). Jean-Louis Campan and André Cottin (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Cadarache). 1963. 26p.

A 4π β counter using plastic scintillators and CEA standard electronics components is described. The counter can be used to determine the absolute activity of detectors used in studying neutron flux distributions. A special study was made of the activity of powdered sulfur detectors. The sources of error were analyzed, in particular the uncertainty in the exact weight and the β self-absorption. The total error is about 2%. (auth)

22004 (CISE-93) EFFETTO DELLA DENSITÀ DI CAMPIONI LIQUIDI CONTENENTI P^{32}, I^{131}, Au^{198} SUL RENDIMENTO DI CONTATORI DI GEIGER E MÜLLER A INTERCAPEDINE. (Effect of Density of Liquid Samples Containing P^{32}, I^{131}, Au^{198} on Response of Geiger–Mueller Tube). C. Garavaglia and F. Bellini (Centro Informazioni Studi Esperienze, Milan). Dec. 1962. 27p.

The results of experiments made with two cavity counters (with different yield for different wall thickness) on the

behavior of the counting frequency with the increase of the density of the measurement liquid are reported. The isotopes studied were P^{32}, I^{131}, and Au^{198}, and the density interval explored was between 1000 and 1400. The slopes (angular, relative, percentage) of the lines analytically interpolated between the empiric points are given. A statistical analysis is set up to test the significance of the differences found between the lines obtained with the two counters with respect to the same isotope. Only I^{131} shows a statistically significant difference. A brief discussion on these results and other observations is given. (tr-auth)

22005 (EURAEC-587) SOLID STATE NEUTRON DETECTOR. Final Report. (Mol, Belgium. Centre d'Etude de l'Energie Nucleaire). [1962]. Work Performed Under United States–Euratom Joint Research and Development Program. Contract 079-61-10-RDB. 58p.

A neutron detector is developed for the detection of high neutron fluxes at high temperatures using silicon carbide as the base material. Silicon carbide p-n junctions maintain their rectifying properties at 500°C and develop a rather high photovoltage under gamma radiation. An extensive series of tests performed on the silicon carbide crystal are included. (C.E.S.)

22006 (HW-68525) THE RESPONSES OF VARIOUS DETECTOR SAMPLE ARRANGEMENTS FOR GAMMA-RAY SPECTROMETRIC MEASUREMENTS. R. W. Perkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. Contract AT(45-1)/1350. 54p.

The relative counting efficiencies and γ spectral responses of a number of NaI(Tl) detectors with various sizes of samples were compared. The detectors used for these evaluations included solid crystals 3 in. in diameter by 3-in. thick and 9 in. in diameter by 4-in. thick, and well crystals 5 in. in diameter by 5-in. thick and $9\frac{3}{8}$ in. in diameter by $8\frac{1}{2}$-in. thick. Arrangements were evaluated with these detectors as summing systems, as coincidence summing systems and in anticoincidence shielding. The responses of these systems and their relative efficiencies were compared for point sources and for liquid sources ranging up to about 9 liters. Where sample size is unlimited, the maximum sensitivity for the measurement of a radioisotope usually is obtained by placing a large crystal within a large sample. The maximum photopeak-to-Compton ratio is available if a point source of the sample and anticoincidence shielding is used. The direct comparison of the responses from different sizes and shapes of samples for the various detector systems permits a good estimation of the relative sensitivities of the various systems for any specific application. For comparison with NaI(Tl) detectors, the response of a large plastic phosphor is included. (auth)

22007 (IDO-12029) AUTOMATIC FILM DENSITY READING SYSTEM. Rex B. Purcell and Hal McGary (Idaho Operations Office, AEC). Apr. 1, 1963. 93p.

An automatic film density reading system is described in which dosimetry film is identified with a film badge number preassigned to a particular individual; densities resulting from radiation exposure are observed and converted to voltage readings for each of four fields corresponding to exposures through four filtered media; and these identification and density data, together with additional pertinent information, are automatically recorded on punched paper tape in a format compatible to data processing equipment. Theory of the system is discussed; operating instructions are given; the electronic system is described; and detailed board theory and wiring diagrams are included. (auth)

22008 (LADC-5609) COMPUTER TECHNIQUES IN GAMMA SPECTROMETRY. Phillip N. Dean (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 25p.

Use of computers to analyze gamma spectra that have a primary line structure related to individual gamma rays and in which the continuum results only from scattering is examined. Qualitative and quantitative types of analysis programs are discussed. Results of a qualitative analysis of a composite spectra (shown) of a mixture of Na^{22}, Cs^{134}, Co^{60}, and Y^{88} are given. Results of quantitative analyses of composite spectra of Co^{60}, Sr^{85}, Na^{22}, Cs^{137}, and Mn^{54} and of Ra^{226} and Th^{228} are also presented. The composite spectrum of a fresh milk sample is included as well as results of its quantitative analysis for I^{131}, Cs^{137}, and K. (D.C.W.)

22009 (AEC-tr-5781) PHOSPHATE GLASS DOSIMETER FOR ROUTINE PERSONNEL MONITORING. K. Becker (Kernforschungsanlage, Jülich, Germany). Translated from German for Oak Ridge National Lab., Tenn. 17p.

The measurement of radioinduced fluorescence (radiophotoluminescence) in new silver-phosphate-containing dosimeter glasses proved to be a method superior to photographic film for the routine monitoring of radiation exposure in nuclear plants. The investigation included the sensitivity, pre-dose, accuracy, time and temperature behavior, energy and directional relationship of various glass–metal filter combinations, neutron sensitivity as well as various disturbing influences and an encapsulation for the glass is suggested that permits the registration of from about 0.05 and several thousand roentgen units as well as about 0.04 and several Mev of energy- and directionally independent quantum emission. Special applications and possibilities for improvement are discussed. (auth)

22010 STUDY OF SOME ORGANIC SCINTILLATORS IN SOLUTION. Margareta Tibu, Candiano Leonte, and I. Viscrian. Acad. Rep. Populare Romine, Filiala Iasi, Studii Cercetari Stiint., Fiz. Stiinte Tehn., 12: 199-205 (1961). (In Rumanian)

The characteristics of three organic scintillators 2,5-diphenyloxazole, p-terphenyl, and 1,6-diphenyl-1,3,5-hexatriene in toluene solution were studied for their adaptation to a photomultiplier. After a description of the preparation of these compounds and the test installation, the curves for the counting rate variation for different discrimination voltages and the total current of the P-M anode, measured as a function of the concentration of the scintillators in toluene, were given. It was established that there is a non-linear displacement with respect to concentration in the nuclear spectrum and that diphenylhexatriene is not usable with the tube studied. (tr-auth)

22011 TRANSISTORIZED PORTABLE GAMMA RADIATION DETECTOR. Fermín Navascués and Agustín Tanarro (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 255-60(Sept.-Oct. 1962). (In Spanish)

A simple portable Geiger detector is described. The 900 volt stabilized h-v supply for operating the Geiger tube consists of a transistorized blocking oscillator, a two cold-cathode tube voltage multiplier circuit, and a corona voltage regulator tube. The counting rate meter circuit employs three transistors and a 50 microamp instrument. Three

sensitivities with 10, 50, and 250 counts per second at full scale, approximately equivalent to 0,5, 2,5, and 12,5 milliroentgens per hour, are provided. The power supply consists of a 6 volt dry cell battery with a drain of 16 ma. (auth)

22012 MEASUREMENT OF DISTORTION IN NUCLEAR EMULSIONS. J. Catalá, E. Villar, A. Lleó, G. Pardo, and J. M. Pérez (Facultad de Ciencias, Valencia). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 273-8(Sept.-Oct. 1962). (In Spanish)

In collaboration with a nuclear plate experiment carried out in the protonsyncrotron of CERN, the distortion of the plates was measured. The distortion maps for three plates are shown and the distortion mean values over the useful area are found for energy measurement. (auth)

22013 THE PHOTO-EFFICIENCY OF THE NaI(Tl) CRYSTALS FOR UNCOLLIMATED γ-RADIATION. Yu. S. Korda, G. F. Timoshevskii, and V. V. Remaev. At. Energ. (USSR), 14: 319-20(Mar. 1963). (In Russian)

The recording efficiency of the γ-quanta having various energies by means of scintillation detectors containing NaI(Tl) crystals was determined previously by the Monte Carlo method. In order to further clarify this point, the photo-efficiency of the NaI crystal for a divergent γ-ray beam from a point source was measured in the range from 60 kev to 1.5 Mev. Use of a direct method is justified because the crystal is an efficient detector. Emission of photons with an energy less than 40 kev was neglected in the calculations. The photo-efficiency, the total efficiency, and photo-interaction were plotted as a function of energy with an error estimated to be less than 2%. When the photo-efficiency curve is used below the 100-kev photon-energy level, the emission peak, i.e., the case when the x-ray quantum of I (about 28 kev) is emitted by the crystal, must be taken into consideration. (TTT)

22014 A NEW METHOD OF MEASURING THE GAS GAIN OF A FLOW PROPORTIONAL COUNTER. A. J. Campbell (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). Brit. J. Appl. Phys., 14: 221-2 (Apr. 1963).

A method for determining the absolute gas gain of a flow proportional counter is discribed. The method requires only two sets of pulse height measurements in order to obtain the variation of pulse height with counter voltage and with gas density. The method is particularly suitable for flow counters since the temperature and pressure of the gas must be controlled if the gas gain is to be kept constant; so no additional apparatus is needed in order to vary the gas density. The only physical assumption made is that secondary gas processes can be ignored. (C.E.S.)

22015 A NOTE ON A PORTABLE BATTERY OPERATED HIGH VOLTAGE SUPPLY. M. Rama Rao and J. K. D. Verma (Saha Inst. of Nuclear Physics, Calcutta). Electro-Technol. (Bangalore), 5: 453-4(Sept.-Oct. 1961). (In English)

A light weight, battery operated, regulated, high voltage supply is described that is capable of delivering up to 40 microamperes at 1200v to provide the high voltage needed for operating G. M. counters and photomultiplier tubes in portable radiation survey instruments. The unit comprises of a vibrator-transformer and is operated on two 1.5v batteries. The entire assembly including batteries, weighs approximately 500 gm. The rectifier—a cold cathode tube—and the regulator are both miniature ones. For intermittent operation, the batteries provide the source of power for nearly three hours. Compactness, low cost, ruggedness and good regulation are some of the essential features. (auth)

22016 A SLOW NEUTRON CRYSTAL SPECTROMETER. G. Giacchetti, M. Musci, and G. Poletti (CESNEF, Milan and CISE, Milan). Energia Nucl. (Milan), 10: 173-83(Apr. 1963). (In Italian)

A single-crystal neutron spectrometer is described, which can be used for good resolution work in the energy range from 0.03 ev to a few ev. The limits of applicability of the device are discussed; they are essentially due to contamination from higher-order reflections in the low-energy region and to the beam geometry and intensity in the higher-energy region. Pb, LiF, and Cu crystals were studied as monocromators both with reflection and with transmission technique. The preliminary experimental results point out that the resolution of the spectrometer is satisfactory in the above mentioned energy range. (auth)

22017 PARAMETERS FOR GEIGER DISCHARGE. Jean Kern (Université, Fribourg, Switzerland). Helv. Phys. Acta, 36: 12-40(1963). (In French)

Measurement of the charge per count q was made in the proportional and Geiger region with a counter of variable anode diameter 2 a filled with an ethanol-argon mixture. This allowed a precise determination of the Geiger starting voltage V_s, which is shown to obey very closely the Wilkinson equation. The value of ϵ was determined from the increase of q above V_s, ϵ being the probability per ion that a further avalanche should arise. It was found that ϵ varied between 1.5 and 5×10^{-6} as a function of a, although it was supposed to be a constant for a given mixture. This could be due to the formation of a greater number of excited atoms per ion for the smaller than for the greater anode diameters. Nevertheless it is probable that this is a consequence of the fact that the first Townsend coefficient is no longer proportional to the field above V_s for the small a values. The mean ϵ value, i.e. 1.9×10^{-6}, determined from the measurements in the Geiger region with the greatest anode diameters agreed to 10% with the one deduced from the study of the proportional region. The breaks in the m = f(V) characteristics occurred exactly at m = 1. Further breaks were found at higher m values. The slope ratio above and below V_s was 0.40 ± 0.03 on the average, compared to a theoretical value of 0.47. The Korff-Present effect is shown to contribute very little to the breakdown of the quenching mechanism. The appearance of giant impulses, which are followed by an average of 3 spurious counts approximately, plays an important role when the anode diameter is greater than 0.2 mm. Decay of excited argon atoms is probably responsible for the breakdown when the anode diameter is smaller. (auth)

22018 A LOG N AND PERIOD AMPLIFIER UTILIZING STATISTICAL FLUCTUATION SIGNALS FROM A NEUTRON DETECTOR. David A. Gwinn and William M. Trenholme (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Elec. Electron. Engrs.) Trans. Nucl. Sci., NS-10: No. 2, 1-9 (Apr. 1963).

A novel approach to the logarithmic measurement of neutron level and period in a nuclear reactor is described, in which the statistical fluctuations in the output of a neutron detector are utilized rather than the individual pulses or the d-c component. This approach is shown to overcome some of the limitations that are inherent in the usual log n and period amplifier systems. A system using a fission chamber as detector and all solid-state circuitry is shown which covers a six-decade range of neutron level between the

limits of 10^3 and 10^{10} nv without the need for low level d-c amplification. (auth)

22019 THE BRITISH NATIONAL HYDROGEN BUBBLE CHAMBER. Instr. Pract., 17: 380-1(Apr. 1963).

A description of the British national hydrogen bubble chamber is given. The chamber is the largest in the world and the main experiments will be on beams of antiprotons and mesons (K). (C.E.S.)

22020 A DOUBLE β-SPECTROMETER FREE OF IRON AND HAVING A TOROIDAL FIELD. E. F. Tret'yakov, L. N. Kondrat'ev, G. I. Grishuk, G. I. Novikova, and L. L. Gol'din (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1470-4(Dec. 1962). (In Russian)

The main parts of the spectrometer are two coils, each of which consists of 600 turns assembled in 10 packets. The coils are connected in series, and the shape of the turns is symmetrical around the mid-plane of the coil. The distance between the source and detector is 800 mm for one coil. The windings are stamped from copper 0.7 mm thick. The coils weighed 400 kg apiece, and were mounted on top of each other. A scintillation counter with a stilbene crystal was used as a detector. A stabilized power supply of 3 to 70 amp at a voltage up to 80 v (up to 160 v for a series hook-up of the coils) is described as a feed to the coil. Tap water is used to cool the coils. The earth's magnetic field is reduced by a factor of 50. The two coils were identical and could be connected in series without any adjustment. The resolution is 0.45% for one coil with a source 4 mm in diameter and an exit diaphragm 5 mm in diameter. The count rate is 10% of 4π with the diaphragm open, or it is 2% at a resolution of 0.45%. The resolution with a wide exit diaphragm and a source 4 mm in diameter is 1%. With the two coils in series, the count rate increases by a factor of 1.5, and the resolution rises to 0.30%. These characteristics were determined for the L_{II}-line of the conversion electrons from the 100.1 kev transition in W^{182}. (TTT)

22021 THE POSSIBILITIES OF USING SOLID-STATE SILICON DETECTORS IN NUCLEAR STUDIES. L. V. Maslova, O. A. Matveev, S. M. Ryvkin, N. B. Strokan, D. V. Tarkhin, and V. G. Khozov. Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1498-1505(Dec. 1962). (In Russian)

The properties of various kinds of solid-state silicon developed at the Institute of Technical Physics in Leningrad are discussed, and data on the resolution and electronic circuits are given. Detectors made from n-type silicon with a specific resistance of 100 to 200 ohm-cm have working areas of 4, 25, and 50 mm^2. The applied potential is 200 times the contact potential (V = 200 v), and the width of the sensitive volume layer d = 100 μ. The resolution for the 4.816-Mev α particles of U^{233} is better than 0.5% (~25 kev). A large surface-barrier detector with a sensitive area of 5 cm^2 shows a resolution of only 7% or 350 kev for 5-Mev α particles at a signal to noise ratio of 10. These detectors can still be used to count fission fragments, where the signal to noise ratio is ~100, and a resolution of 7% is frequently satisfactory. With the use of a diffusion-drift technique of introducing lithium into p-type silicon, a counter having a sensitive area of 4 cm^2 and a width of ~2 mm was developed that could count 5-Mev α particles at a signal to noise ratio of 50. Circuits of a preamplifier and a transistorized amplifier are presented for use with solid-state counters. (TTT)

22022 THE ENERGY RESOLUTION OF SOLID-STATE, (p-n)–SILICON DETECTORS IN COUNTING HEAVY IONS. D. G. Alkhazov, Yu. P. Gangrskii, I. Kh. Lembert, and Yu. I. Udralov. Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1506-7(Dec. 1962). (In Russian)

A well-collimated beam of N^{14} ions having energies of 18 to 50 Mev was analyzed on a solid-state silicon detector having an area of 2×2 mm^2. The potential applied to the detector varied from 10 volts for 18-Mev ions to 40 volts for the 50-Mev ions in order to absorb the ions in the sensitive volume of the detector. The energy scatter in the ion beam was less than 0.03 Mev. A gold scattering foil was used to attenuate the N^{14} ion beam. The pulse amplitude from the silicon detector varied directly with the energy of the bombarding particles. The energy resolution of the silicon detectors was 1 to 2.5%, and depended on the properties of the silicon detector. The energy resolution of the 5.48-Mev α particles from Am^{241} was also 1 to 2.5%, and the pulse height of the Am^{241} α particles lay on the straight line obtained for the pulse heights of the 18 to 50-kev N^{14} particles. (TTT)

22023 TWO-CHANNEL WELL-LOGGING γ SPECTROMETER. V. I. Utkin and Yu. B. Burdin (Inst. of Geophysics, Academy of Sciences, Ukrainian SSR). Izv. Akad. Nauk SSSR, Ser. Geofiz., No. 3, 464-72(Mar. 1963). (In Russian)

Descriptions are given of a two-channel well logging spectrometer used for geophysical studies. (tr-auth)

22024 MULTIPLE-SCREEN CALORIMETER FOR MEASURING BETATRON EMISSIONS. B. A. Kononov and V. N. Rudenko (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 6, 147-51(1962). (In Russian)

Descriptions are given of a two-screen calorimeter operating without continuous pumping and without a thermostat. The calorimeter is capable of measuring beam intensities from 3×10^3 to 5×10 erg/cm^2 sec with an order of accuracy to 5%. (R.V.J.)

22025 A SIMPLE SOLAR-CELL X-RAY MONITOR. R. S. C. Cobbold and N. J. Jackson (Univ. of Saskatchewan, Saskatoon). J. Appl. Physiol., 18: 209-10(Jan. 1963).

An x-ray detector in which the basis of operation is a p-n junction, silicon solar cell is described. When such a cell is bombarded by x rays, hole-electron pairs are liberated, some of which become separated by the electric field existing at the junction and are responsible for the generation of a voltage at the terminals of the device. The power available from the cell is proportional to the junction area, so that by using a large area cell the degree of subsequent amplification required can be minimized. The radiation damage threshold for silicon is ~ 0.3 Mev, so that deterioration of the cell characteristics for normal diagnostic operation of the x-ray tube presents no problem. Measurements of the cell characteristics before and after being subjected to a total radiation dose of 6000 r (at 100 kv) showed no detectable change. Since output from the cell used was inadequate, a transistor differential preamplifier was used. The x-ray monitor enables an output to be obtained that is a measure of the x-ray voltage and current. However, if an output is required that is independent of these factors, the amplifier can be followed by a simple transistor limiter to yield a constant output. The complete device can be assembled for less than $25. (TCO)

22026 SCINTILLATION COUNTER FOR SIMULTANEOUS ASSAY OF H^3 AND C^{14} IN GAS-LIQUID CHROMATOGRAPHIC VAPORS. G. Popják, A. E. Lowe, and D. Moore (Hammersmith Hospital, London). J. Lipid Res., 3: 364-71 (July 1962).

An instrument for the assay of H^3 and C^{14} in gas-liquid chromatographic effluents is described. An important change is the placing of a photomultiplier on each side of the counting chamber. Two fully transistorized counting channels were designed, each of which can be set independently for the detection of β rays of different energies. Radioactive analysis is practically simultaneous with the mass analysis. By the use of coincidence circuitry and pulse-height analysis with discriminators it is possible to measure simultaneously 2 radioactive isotopes contained in the same sample. Furthermore, the addition of a subtracting circuit to the electronic system permits the independent recording of C^{14} and of H^3 counts. The instrument gives highly reproducible results; the maximum variation observed in counting a mixture of C^{14}-labeled fatty acid esters was ±3%. Less than 0.1% of the H^3 counts appear in the C^{14} channel, which (excepting specimens of very high H^3 and low C^{14} content) may be neglected. On the other hand, about 16% of the C^{14} counts are also recorded in the H^3 channel. The instrument is particularly suitable for the analysis of radioactive substances of high volatility. The electrical circuitry for subtraction of C^{14} pulses from H^3 channel counts during simultaneous assay of the two isotopes with the aid of ratemeters is appended. (TCO)

22027 A SIMPLE CALORIMETER TO MEASURE ENERGY ABSORPTION FROM HIGH RADIATION FIELDS IN NUCLEAR REACTORS. J. S. Heath (Associated Electrical Industries (Manchester) Ltd., Eng.). J. Sci. Instr., 40: 261-2(May 1963).

An adiabatic calorimeter used in conjunction with a pneumatic sample transfer system is described. Results indicate that useful measurements may be made of nuclear heating rates above 20 mw g^{-1} and that by improving the present arrangement the useful range might be extended to 5 mw g^{-1}. (auth)

22028 PLASTICS IN IONIZATION RADIATION DOSIMETRY. Max Možíšek (Inst. of Rubber and Plastic Tech., Gottwaldov, Ger.). Jaderna Energie, 9: 81-5(1963). (In Czech)

The change of properties of plastics induced by ionization radiation may be utilized in radiation dose measurement in the range from 10^5 to 10^8 rad. Dose meters made from plastics may be of use mostly in radiation chemistry and in polymer technology. These methods usually are based on radiation polymerization, graft polymerization and degradation, gaseous product release, and coloring (tinting) of polymers effected by ionization radiation absorption. (auth)

22029 JENA SCINTILLATORS. Werner Luedke. Jenaer Rundschau, No. 1, 8-11(1961).

Physical properties of scintillators used in particle scintillation counters are examined and their characteristics are given. In order to locate γ quanta, inorganic crystals are utilized, especially NaI and CsI, and Ta, Eu, and Ar are used for activation. The scintillation period in the NaI(Tl) crystals is 0.25×10^{-6} sec, the effectiveness of recording of γ quanta equals 90% with the energy of 100 kev and 40% with the energy of 1 Mev. In order to obtain a large NaI monocrystal, two methods are used. CsI ensures great probability of photoabsorption, and in contrast to NaI it is nonhygroscopic. CsI is also a good α detector. Other inorganic crystals [KI(Tl), RbI(Tl)] have a light output 5 times lower than NaI. In the α detectors ZnS and other organic materials or crystals are used, the scintillator being made in the shape of a thin lamina (~1 μ). Chemical purity is obtained by purification and polymerization methods. Inert gases can be used as scintillators for α-rays. Fast electrons produce light emission of scintillators and the slow ones are located as they produce α- and γ-radiations; scintillators can be used as neutron detectors. Photographs of crystals and tables of characteristics are given. (TCO)

22030 AUTOMATIC HIGH VOLTAGE CONTROL FOR GEIGER-MUELLER COUNTERS. H.-U. Gersch and G. Lang (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 42-5(Jan. 1963). (In German)

An automatic control device was constructed for the counter of a magnetic spectrometer. With this device the counter can be operated steadily in the most favorable region of its plateau. Experimental testing showed a control accuracy of the counter voltage of about 10 v at pulse densities of 1000 pulses/min. (tr-auth)

22031 THERMOLUMINESCENCE DOSIMETRY WITH LiF AND ENERGY DEPENDENCE OF THERMOLUMINESCENCE DOSIMETERS USING THE PHOSPHORS CaF_2 : Mn AND LiF. M. Frank (Technische Universität, Dresden). Kernenergie, 6: 76-80(Feb. 1963). (In German)

The phosphor LiF is suitable for dose measurements of γ and x radiation in a region from 0.1 to 1000 r. An illumination apparatus available for routine operations is described. The wavelength dependence of CaF_2 : Mn and LiF was calculated with the result that with CaF_2 : Mn energy-dependent dose measurements are possible in the region above 0.2 Mev; with LiF they are possible in the entire spectral region. These statements were checked experimentally with gamma-emitting nuclides. (tr-auth)

22032 SEMICONDUCTOR DETECTORS FROM THE CENTRAL INSTITUTE OF NUCLEAR PHYSICS AT ROSSENDORF. C. Kaufmann and J. Schintlmeister. Kernenergie, 6: 83(Feb. 1963). (In German)

The characteristics of semiconductor detectors used in nuclear physics measurements are described. (M.C.G.)

22033 A DIRECT READING PEN-DOSIMETER WITH RADIATION ELEMENT. R. Hosemann and H. F. H. Warrikhoff (Max-Planck-Gesellschaft, Berlin). Kerntechnik, 5: 114-17(Mar. 1963). (In German)

All direct reading dosimeters used in practice operate electrically. The most common instrument of this type is the ionization chamber. For high doses radiation damages of the dielectricum occur, especially if condensors are used. High dose rates cannot be measured quantitatively. The advantage of the semirad, developed by the US Signal Corps, is the ability of measuring the highest dose rates at present attainable as well as high doses quantitatively. In contrast to the discharging dosimeters, the dosimeter with radiation element (self charging dosimeter, "nuclear battery"), described, has some further advantages: since no auxiliary supply is needed, it is continuously able to measure at any moment for a long time. The error of the measurement due to the leakage is much lower than that of the discharging dosimeters. The dosimeter with radiation element contains a special control unit, so its reliability is also greater. (auth)

22034 THE WHOLE BODY COUNTING FACILITY AT BERLIN. P. Koeppe (Freie Universität, Berlin). Kerntechnik, 5: 117-21(Mar. 1963). (In German)

The purpose of the Berlin Body Counter, its mechanical construction, and electronic equipment are described. Basic data on sensitivity are presented. (auth)

22035 THE MEASUREMENT OF ^{41}A WITH A CLOSED IONIZATION CHAMBER. G. Hasl (Universität, Frankfurt am Main). Kerntechnik, 5: 122-4(Mar. 1963). (In German)

The calibration of a closed ionization chamber for the measurement of Ar^{41} expelled through the chimney of the reactor FRF is treated. For the sensitivity of this chamber 0.68×10^{-11} Ar $cm^{-3}/\mu c$ cm^{-3} was obtained. A calculation of the ionization current in consideration of the β spectrum of Ar^{41} and a mean range inside the chamber (the usual basis of the concept) resulted in a value which was about a factor 3 smaller than the measured one. The contribution of Ar^{37} to the ionization current can be neglected. (auth)

22036 AN IN-PHANTOM RADIATION DETECTOR. Majic S. Potsaid and Goro Irie (Massachusetts General Hospital, Boston). New Engl. J. Med., 265: 1135-9(Dec. 7, 1961).

A solid system capable of detecting as well as measuring the amount of radiation absorbed, and composed of several easily controlled organic molecules that can be prepared economically, was devised for experimental and clinical applications. It permits the study of radiation effects in a material whose density can be made closely equivalent to that of living tissues. The structural complex is an in-phantom chemical radiation dosimeter where the dosimeter is the phantom and the phantom itself is a dosimeter. The system contains specific chemicals and matrix materials: chloroform and bromoform in 8 to 20% concentrations by weight in a paraffin-wax base containing 100 mg dimethylaminoazobenzene per kg of total material. The bright yellow model is immediately transformed to red in the irradiated parts of the dosimeter or phantom. The absorbed energy, electromagnetic or corpuscular, determines the magnitude of the chemical reaction. Electromagnetic radiations (for example, x and γ rays) and corpuscular radiations (electrons, protons, and neutrons) show color changes that are proportional to the amount of absorbed radiant energy. Some dosimeter mixtures show definite color changes below 100 rad, with deep colors by several hundred rad. The in-phantom radiation detector can be shaped into the desired 3-dimensional geometries and even molded or sculptured to simulate human or animal anatomy. Some experiments with the detector are briefly described. (TCO)

22037 RADIANT FLUX DENSITY MEASUREMENT OF PULSE-MODULATED NUCLEAR RADIATION BY PARTICLE COUNTERS. Yasutomo Ozawa, Masakuni Narita, and Ikuo Kaji (Hokkaido Univ., Sapporo, Japan). Nippon Genshiryoku Gakkaishi, 5: 190-4(Mar. 1963). (In Japanese).

A formula of dead-time losses for pulse-modulated nuclear radiation was derived and experimentally verified. It was also clarified by the use of an electron linear accelerator that the intensity of nuclear radiation could be measured by counting rate measurements, if this dead-time correction was made. (auth)

22038 MEASUREMENT OF INTEGRATED RADIATION BY MERCURY-MICROCOULOMETER. [PART] I. Tamotsu Yamada (Nagoya Inst. of Tech., Japan). Nippon Genshiryoku Gakkaishi, 5: 231-5(Mar. 1963). (In Japanese)

In a capillary-type mercury microcoulometer, the electrolytic solution is displaced toward the positive side. By microscopically measuring this transposition down to 10^{-4} mm with a screw-micrometer eyepiece, a coulometer of 0.1 to 0.03 mm diam. can have a sensitivity of 10^{-5} to 10^{-6} coulombs. The method of determining total radiation by integrating the current through a GM counter tube using this sensitive coulometer is discussed. The charge of the GM counter Q by radiation is Q = Ane where A is gas amplification, e charge of electron, and n the number of ions formed by the radiation. With a GM counter Q may reach 10^{-10} to 10^{-12} coulombs. This charge produced by radiation was integrated by connecting in series the coulometer and high-voltage source to the GM counter tube. (In this experiment a microammeter was used for measuring the leak current and the GM counter current). The following results were obtained: (1) When radiation of constant intensity was integrated, the displacement corresponded to the duration of integration. (2) Displacement per hour corresponded to the rate of radiation up to 30×10^3 cpm. The reason for this is discussed from the dead time of pulse counting. (3) The displacement corresponded to the integrated counts of radiation. From the above data the charge of one pulse was calculated to be 2×10^{-10} coulombs as expected. (4) The effect of the GM counter tube overvoltage on radiation integration was measured and discussed. From these studies on the capillary-type mercury microcoulometer, it was established that with this device any radiation up to 10^4 cpm can be measured and integrated at will. (auth)

22039 IMPROVEMENT OF THE ENERGY DEPENDENCE OF COUNTERS. H.-J. Hardt and E. Lutz. Nukleonik, 5: 39-40(Jan. 1963). (In German)

The possibility of improving the energy dependence of counter tubes by the use of Pb filters with small perforations was investigated. It was determined that the optimum results were obtained with a cylindrical filter of work-hardened Pb with 9-mm exterior diameter and 1-mm wall thickness with 12 holes of 1.3-mm diameter. The holes are arranged in two staggered planes of 6 each. The energy dependence curves are shown for a counter tube without filter and for three filters. (J.S.R.)

22040 UP-TO-DATE METHODS OF GAMMA SPECTROSCOPY (A REVIEW). A. M. Demidov (Inst. of Nuclear Energy, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 5-20(Jan.-Feb. 1963). (In Russian)

A review is given of spectral methods for γ emissions. Luminescence spectrometers with NaI(Tl) crystals and magnetic and diffraction spectrometers are described. Their efficiencies, resolving properties, and other characteristics are compared. (tr-auth)

22041 IDENTIFICATION OF MULTICHARGED PARTICLE SHORT DISTANCE TRACKS IN NUCLEAR EMULSIONS. P. A. Gorechev and O. V. Lozhkin (Radium Inst., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 30-5(Jan.-Feb. 1963). (In Russian)

Descriptions are given of a semiautomatic device for measuring particle track widths in emulsions. Characteristics of boron and carbon tracks (the width and integral width) were analyzed in an effort to develop better discrimination. (tr-auth)

22042 CERTAIN CHARACTERISTICS OF SPARK DETECTORS. Yu. D. Bayukov, G. A. Leskin, D. A. Suchkov, and V. V. Telenkov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 36-8(Jan.-Feb. 1963). (In Russian)

Spark detector efficiency as functions of the discharge chain and chamber volume parameters was analyzed. The effects of simultaneous particle recordings and of working gas dilution on the efficiency are also discussed. The article is a continuation of work by S. M. Raiskii et al. (Physical Principles of the Radioactive Indicator Methods, Gostekhizdat, 1956). (tr-auth)

22043 ESTIMATE OF COSMIC RADIATION CONTRIBUTION TO GAS COUNTER BACKGROUND. E. I. Markichev. Pribory i Tekhn. Eksperim., No. 1, 39-41(Jan.-Feb. 1963). (In Russian)

The contribution of cosmic radiation to the background of a counter and the method of determining the contributing effect as a function of lead shield thickness are analyzed using four counters with 0, 3, 5, 8, 10, and 13 cm lead shields. Tabulated results show that increased shield thickness (7 cm) excludes the effects of soft cosmic ray components but does not absorb hard components. (R.V.J.)

22044 RECORDING OF PULSED X RADIATION BY CAPACITOR IONIZATION CHAMBER. S. F. Kilin, G. E. Murguliya, and I. M. Rozman (Inst. of Physics and Tech., Academy of Sciences, Georgian SSR). Pribory i Tekhn. Eksperim., No. 1, 42-5(Jan.-Feb. 1963). (In Russian)

Capacitor ionization chambers for recording x-ray emissions at several kv are described, and experimental data on photon absorption coefficients in air, krypton, and xenon and in the chamber gas are tabulated. (R.V.J.)

22045 ELECTRON ADAPTER FOR MULTI-CHANNEL ANALYZER AI-100-1. Kh. Deler (Central Inst. of Nuclear Physics, Rossendorf, Ger.). Pribory i Tekhn. Eksperim., No. 1, 46-52(Jan.-Feb. 1963). (In Russian)

Descriptions are given of an adapter for a 100-channel analyzer (AI 100-1) that allows a wider scope of operation. The analyzer can be operated as two 50-channel sections. The operation time of the device is set at 28 sec to 2 hours. The upper and lower incoming pulse limits are calculated, and block diagrams of various sections are given. The delayed γ spectrum for Ho^{166m} (n,γ) reactions was analyzed. (tr-auth)

22046 PULSE AMPLITUDE ANALYZER AIMA-2. M. A. Pasechnik, R. G. Ofengenden, L. D. Konenko, and M. A. Shaleiko (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 1, 57-60(Jan.-Feb. 1963). (In Russian)

The design is given of a table size multi-channel pulse amplitude analyzer with a discriminating magnetic memory for pulses in each channel. (tr-auth)

22047 FAST COINCIDENCE SCHEME FOR DELAYED SCINTILLATORS. S. S. Batalin, D. K. Kaipov, and V. N. Chekanov (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Pribory i Tekhn. Eksperim., No. 1, 61-3 (Jan.-Feb. 1963). (In Russian)

A fast coincidence scheme was used in a fast-delayed coincidence device for selective determination of certain spectral sections. The resolving time was $2\tau = 6$nsec at 100% efficiency for Co^{60} and In^{114} gammas. (tr-auth)

22048 TRANSFORMATION OF PULSE AMPLITUDE RATIOS INTO A PULSE WITH PROPORTIONATE AMPLITUDE. R. G. Ofengenden and N. M. Parovik (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 64-6(Jan.-Feb. 1963). (In Russian)

Transformation of the ratio of simultaneously appearing pulse amplitudes into a pulse with an amplitude directly proportional to that ratio was analyzed. With the pulse amplitude ratio equal to one, the output signal has a maximum value. A general formula was developed for determining transformation errors. (tr-auth)

22049 DETECTOR OF DELAYED MESONS. A. F. Dunaitsev, V. I. Petrukhin, Yu. D. Prokoshkin, and V. I. Rykalin (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 1, 159-61(Jan.-Feb. 1963). (In Russian)

Descriptions are given of a high-selectivity scintillation delay detector capable of recording up to $K \approx 50$ π^+ meson delays. The detector selectivity is based on the difference in ionization losses. The instrument was tested using 75-Mev π^+ beams passing through monitoring scintillation counters, delayed by polyethylene filters, and stopping in the last scintillator. The mesons were recorded by a fast coincidence scheme. (R.V.J.)

22050 MEASUREMENTS OF LIGHT YIELD FROM LARGE SIZE SCINTILLATORS. Ya. P. Velogurov, L. N. Shishova, G. A. Kivalchich, and V. I. Talus (All-Union Research Inst. of Monocrystals, USSR). Pribory i Tekhn. Eksperim., No. 1, 161-2(Jan.-Feb. 1963). (In Russian)

Descriptions are given of a method and apparatus for measuring relative light yield in a 78-l plastic block from the total absorption of Co^{137} gammas. The amplitude resolution of the total absorption peak is ~20%. Five FEU-24 photomultipliers were used in the experiment. (tr-auth)

22051 RADIATION DETECTORS. W. Abson. Proc. Inst. Elec. Engrs., (London), Pt. B, 109: 359-69(Sept. 1962).

Three new and important lines of development in nuclear radiation detection and measurement are presented. Two of these developments, spark chambers and image-intensifier/luminescent-chamber systems, enable pictures or other records of nuclear particle tracks to be obtained with a much higher degree of time resolution than is possible with existing techniques, e.g., with cloud chambers or bubble chambers. This is an important step forward in measurement techniques for the study of rare processes in nuclear reactions, in the presence of large-particle fluxes or of other interfering reactions. Image intensifiers might also be used for observation of Cherenkov radiation and the determination of particle velocities. Measurement of the Cherenkov angle, i.e., the angle between a particle path and the direction of emission of its associated Cherenkov radiation, is the only method applicable for accurate measurement of velocity for particles traveling at speeds within 0.1% of the speed of light. Developments in the design and use of semiconductor nuclear-particle detectors are discussed. An outline of the main principles of these methods of measurement with a summary of device techniques and characteristics and their application to nuclear radiation measurement are given. A brief survey is also given for other miscellaneous topics relating to scintillation and gas-ionization radiation detectors. (auth)

22052 TIME OF COUNT RADIATION MONITORS. V. N. Afanas'ev. Radioaktivn. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 3: 203-4(1961).

The advantages of the method are considered. The measurement is performed by pulse-counting so that very low intensities can be recorded and the zero-point drift is absent. The signal can be transmitted conveniently over a long distance without distortion. Each measurement consists of counting a given number of pulses, thus ensuring equal statistical errors of all measurements determined by the selection of the number of pulses to be counted. It is borne out by practical experience that the time of count radiation monitors are suitable for control and regulation of a wide range of technological parameters. (Referativnyy zhurnal, Avtomatika i radioelektronika, No. 12, 1961)

22053 METHOD AND APPARATUS FOR CONTINUOUS DIRECT MEASUREMENT OF RADIOACTIVITY ON THE EARTH'S SURFACE. Ulrich O. Schanze. Staedtehygiene, 10: 207-12(Oct. 1962). (In German)

A brief review is given of the apparatus and installations presently in use for the continuous direct measurement of radioactivity on the earth's surface. Monitoring devices used only for dust and aerosol measurements are not considered. The characteristics of installations using G-M

tubes, ionization chambers, and scintillation counters as the sensing elements are discussed. (J.S.R.)

22054 UNIVERSAL TYPE OF BLOCK FOR A GEIGER-MÜLLER COUNTER. V. A. Grishko. Uch. Zap., Rizhsk. Politekhn. Inst., 1: 81-90(1959).

A new construction of the block for Geiger-Müller glass counters (GC) was developed. The construction complies with requirements for high sensitivity, stability of operation, and accuracy of measurements. The side surfaces of the counters are properly protected with a lead shield (5 cm of Pb). In addition, the background level is lowered to 180 imp/min. The block has a series of advantages that permit varying the number and the type of GC and the magnitude of the body angle; use of a minimum Pb with each GC, which prolongs its life and increases the stability of operation; and the attainment of optimum characteristics of the GC. (TCO)

22055 OVER RADIATION ALARM (Engineering Materials). (Sandia Lab., Albuquerque, N. Mex.). (CAPE-771)

The T-336 over radiation alarm is used with a T-289 air sampler inside a structure to indicate the operational conditions within the work areas where tritium is encountered. The T-336 has 3 lamps, a bell, and a buzzer. Tritium contamination inside the structure causes the red lamp to light and the alarm bell to ring. When the amber light and the buzzer are on it signifies that the T-289 is out-of-order. When the green light burns the T-289 is monitoring properly. (F.L.S.)

22056 LIQUID SCINTILLATION COUNTING SYSTEM (Engineering Materials). (Johnston (William H.) Labs., Inc., Baltimore). 39 units. (CAPE-812(Rev.))

The internal liquid scintillator head consists of a single shield and sample holder with a light shutter and two photomultiplier tubes for coincident liquid scintillation counting. Aliquots of samples of C^{14} and tritium (T) are mixed with an appropriate standard phosphor mixture such as toluene, diphenylox azole (with a secondary solute or wave length shifter). In addition to the usual measurements, the counting rate of each separate channel may be made to study the advantages of coincident operation. The scintillator head may be cooled by a simple ice bath for studies of the temperature effect in decreasing photomultiplier tube noise. (F.L.S.)

22057 ANNULAR GAMMA COUNTER, MARK II (Engineering Materials). (New York Operations Office. Health and Safety Div., AEC). 43 drawings. (CAPE-837)

This annular gamma counter uses a transistorized preamplifier, has high geometry, low background counting rate, low resolution loss, and is not sensitive to electrical or acoustical noise. The counter is used to estimate the health hazard from airborne contamination and dust samples collected on filter paper. (F.L.S.)

22058 AUTOMATIC GAMMA COUNTER MODEL 2 (Engineering Materials). (California. Univ., Livermore. Lawrence Radiation Lab.). (CAPE-842)

This counter is a new model of the counter in CAPE-125. Units 2 through 12, 14, 15, and 18 through 28 of CAPE-125 are used as are Units 27, 28, 30, and 34 of CAPE-124. It has six sample holders. A rotating table and sample holder are raised and lowered hydraulically. It uses a 3-in. crystal phototube. (F.L.S.)

22059 EXPANSION SYSTEM FOR THE 80-INCH BUBBLE CHAMBER (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). 5 drawings. (CAPE-865)

The expansion system is used with the 80 in. bubble chamber which is 80 in. × 25 in. with a depth of 28 in. The expansion system consists of a 6 in. expansion valve contained in a casing $16^{3}/_{4}$ in. in dia. and a 4 lobed core $9^{3}/_{4}$ in. in dia. and 12 in. long. (F.L.S.)

22060 ELECTROSTATIC PRECIPITATOR AND RADIATION MONITOR (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). 13 units. (CAPE-889)

This precipitator and radiation monitor is used to detect the failure of reactor fuel elements. The precipitator rupture monitor consists of an electrostatic precipitator and a shielded beta detector. A volume of 100 cc of helium blanket gas passes through the precipitator every minute. The gas enters and exits through "headers" which improve the uniformity of the gas flow. A gas sample is drawn from the reactor through the precipitator. Any gas nucleus that undergoes beta decay will be attached to a wire drawn through the tube at a linear velocity of 2 in./min. The stainless steel wire is used only once and is then stored. The precipitator is 15 in. long with a volume of 680 cc. It is made of $^{1}/_{16}$ in. thick brass tubing 2 in. OD. The beta detector is 5 in. beyond the precipitator and is a 0.5 mm thick stilbene crystal $1^{1}/_{2}$ in. in dia., attached to a 6655 photomultiplier tube. It is surrounded by a 2 in. thick lead shield. The precipitator monitor has a low sensitivity to background activity and a high sensitivity to changes in the fission product activity. (F.L.S.)

22061 SCINTRAN, MODEL II (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 7 drawings. (CAPE-925)

The Scintran can be used in detecting α and β particles, γ rays, and neutrons by proper selection of the detector probe. Basic modular transistor circuits are used. These include transistor amplifiers, multivibrator, oscillator, mixer-gating circuit, loudspeaker driving circuit, and count rate meter circuit. The instrument is used in all types of usual monitoring, for areas or building, for routine personnel clothing, hand and shoe monitoring, and for surface and object monitoring. If a NaI crystal is used with a phototube, the instrument can be used for γ energy analysis work and specific radionuclide monitoring. (F.L.S.)

22062 CHERENKOV COUNTER (Engineering Materials). (California, Univ., Berkeley. Lawrence Radiation Lab.). 7 drawings. (CAPE-932)

The counter is used in the Bevatron facility to study the angular distribution in K^- meson scattering experiments. A deflecting magnet is also used to reject K^- mesons that decay in flight. Sulfur hexafluoride at 300 psi is used as the filler gas. The counter is 20 in. in dia and 48 in. long. (F.L.S.)

22063 LOW VELOCITY CHERENKOV COUNTER (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). 58 drawings. (CAPE-938)

The counter is used in determining the velocity (Cherenkov effect) of a particle produced by an accelerator. The limit on the range of velocity selection for this camera is $\beta < 0.98$. (See CAPE-946 for the High Resolution Differential Cherenkov Counter.) (F.L.S.)

22064 HIGH RESOLUTION DIFFERENTIAL CHERENKOV COUNTER (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). 5 drawings. (CAPE-946)

This counter is used to determine the velocity (Cherenkov effect) of a particle in studying properties and interactions of particles produced by the Alternating Gradient Synchrotron. The range of velocity selection for this counter is

set at $0.98 < \beta < 1$. The counter distinguishes K from π mesons at momenta as high as 20 Bev/c where the velocity difference $\Delta\beta$ between K and π mesons is 2.8×10^{-4}. The counter has a 90% counting efficiency. (F.L.S.)

22065 COUNTING RATE METER, MODEL 350A (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). 2 drawings. (CAPE-957)

The modifications of the Model 350 rate meter are shown. The rate meter consists of a discriminator, univibrator, cathode follower, charge diode, amplifier, power supply, and alarm. A 700 Scaler power supply is used. The meter was designed to be used with an Easterline Angus Recording meter. (F.L.S.)

22066 LIQUID ALPHA MONITOR (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). 3 drawings. (CAPE-982)

The continuous alpha monitor is used in aqueous streams containing traces of radioactivity. The scintillations are viewed by a photomultiplier tube and indicated by a count-rate meter. The scintillation screen is submerged directly in the water. The instrument has detected concentrations as low as 3.3×10^{-10} curies/ml. The monitor has two parts, the sample cell and housing for the photomultiplier tube, and its magnetic shield and a preamplifier. The sample cell contains a disc-shaped column of water contained on one side and along the edge by a stainless steel cell and on the other side by a ZnS(Ag) scintillation screen mounted on a plastic disc 6 in. in diameter and 1 in. thick. The sample cell can be decontaminated easily if background activity has accumulated in it. (F.L.S.)

22067 IMPROVEMENTS IN GEIGER-MÜLLER TUBES. (to Philips Electrical Industries Ltd.). British Patent 924,156. Apr. 24, 1963. Priority date Aug. 30, 1958, Netherlands.

A G-M counter tube is designed for low background in beta counting. The tube comprises a cathode wall, a convex anode within the wall, and a flat conductive window. The tube is filled with a gas consisting at lease 0.005 vol % halogen. The maximum dimension of the anode parallel to the window is between 0.15 and 0.75 times the largest cathode dimension parallel to the window. The largest height of the discharge space is between 0.25 and 1.5 times the largest window dimension. The smallest distance of the anode from the window is between 0.1 and 0.5 times the largest dimension of the window. (D.L.C.)

22068 GAS-FLOW RADIATION COUNTER WITH VERTICALLY SPACED GRID ELECTRODES FOR MEASURING EXACTLY SIMULTANEOUSLY LOW α- AND β-ACTIVITIES OF WATER AND OTHER FLUID MEDIA. H. Kiefer, R. Maushart, and H. Fessler (to Kernreaktor Bau- Betriebs-GmbH.). German Patent DAS 1,143,591. Feb. 14, 1963. Filed Apr. 1, 1961.

In the patent 1,094,378, a shallow plane proportional counter for measuring very low α- and β-activities of fluid media is given, which consists of a drum-like housing and of parallel spaced planiform grid electrodes located within the said housing and covering the section of the housing. For an exact measurement of very low activities it is necessary for the grid electrodes to cover a plane which is matched to the section of the sample holder. In order not to have to use a series of counters of variable sizes it is proposed to exchange the set of grid electrodes which cover the whole cross section of the housing for a set of exchangable grid electrodes, the plane covered by this being matched to the section of the sample holder. A device for centering the marginal ring of the grids is described. (Gmelin Inst.)

22069 METHOD FOR PLOTTING A REFERENCE MAP FOR EVALUATING THE SCANNER PLOTTED PICTURE OF AN AREAL DISTRIBUTION OF RADIOACTIVE RADIATION. A. Rakow (to Deutsche Akademie der Wissenschaften). German Patent DAS 1,143,935. Feb. 21, 1963. Filed May 16, 1960.

The method described is for plotting a reference map which is to be used for evaluating the scanner-plotted picture of an areal distribution of radioactive radiation. The unknown pulse rates which were plotted by the scanner are to be compared with the known pulse rates of the reference map. For plotting the reference map it is therefore proposed to locate an absorbing wedge between the detector of the scanner and a γ-ray point source, to move the detector and the point source synchronously along the absorbing wedge, and to plot the reference map with the scanner being adapted as when plotting the picture to be evaluated. (Gmelin Inst.)

22070 IONIZATION CALORIMETER FOR MEASURING THE ENERGY OF COSMIC RAY PARTICLES BY THE EMULSION STACK METHOD. N. L. Grigorov and I. D. Rapoport. Russian Patent 145,779. Mar. 22, 1961.

An ionization calorimeter for measuring the energy of cosmic ray particles by the emulsion stack method with the distinctive feature of widening the measurement range of the energy of particles from 10^{12} to 10^{14} ev and higher, and simultaneously localizing the trajectory of particles, consists of an assembly of rectangular, 1- to 2-cm thick Pb or W plates, between which thin (about 0.5 cm) plates of identical shape, made of plastic scintillators, are located. A second ionization calorimeter in which the distinctive feature is making localization more precise to 0.1 to 0.05 cm, contains shower indicators located between the Pb or W plates, shaped exactly as the latter. Another ionization calorimeter with the distinctive feature of obtaining better indication of particle shower in initial stage of development is described. The assembly of plates comprises two rows of Geiger counters, which discriminate the flux of primary particles in a given solid angle. (TCO)

ISOTOPE SEPARATION

Refer also to abstract 22570.

22071 (AERE-Trans-918) AN ELECTROMAGNETIC ISOTOPE SEPARATOR WITH SMALL MAGNETIC FIELD VOLUME. M. von Ardenne, G. Jaeger, F. Koehler, and G. Petter. Translated by D. Loman (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kernenergie, 3: 1177-91(1960). 32p.

A description is given of a magnetic mass separator for high mass transport, with magnet weight reduced to 20 tons and pumping equipment with capacity reduced to 2000 l/sec; details of beam path, design, and construction are included. The reduction of the weight of the separator magnet from about 200 tons, as in the conventional large machines of this type, to 20 tons without appreciable diminution of the mass transport was made possible by the use of a novel optical beam path. The characteristic feature of this beam path is the production of a beam crossover of the ions diverging from the source within the 60° separator magnetic field, by appropriate curvature of the plasma column and optical system of the ion source. The ion source was constituted by a hot-cathode vapor discharge source with axial auxiliary magnetic field, artificially increased cathode fall, lateral extraction of ions, and special construction. A specially noteworthy feature is the thermal decoupling of the charge vaporizing furnace from the arc chamber. This construction eliminates undefined additional heating of the vaporizing furnace owing to the feeding-in of energy from the ion source discharge and to the parasitic backward electron currents; highly stable operation is thus achieved, even when the source is charged with readily vaporizable substances. By greatly reducing the partial pressure of the oil vapor in the beam chamber, the evolution of gas from the cracking of the oil vapor by the high-intensity ion beam was substantially diminished. This made it possible to reduce the requirement for the evacuation equipment to a pump capacity of only 2000 l/sec while still ensuring an operating pressure of only 1 to 1.5×10^{-5} mm Hg. On charging the source with Mg and applying an accelerating voltage of 40 kv, the total ion beam current reached a value of 100 ma. Thanks to the properly adapted ion-optical conditions for the beam, and the low operating pressure, about 80% of this current was directed into the pockets of the collector. (auth)

22072 CONTINUOUS ISOTOPE ENRICHMENT BY A SIMULTANEOUS USE OF ION EXCHANGE AND ELECTROMIGRATION. Hidetake Kakihana, Yoshihiro Mori, and Tadaya Hoshino (Tokyo Inst. of Tech.). Bull. Chem. Soc. Japan, 35: 2055-6(Dec. 1962). (In English)

An apparatus was devised for the continuous isotope enrichment in a plurality of ion exchange columns with a horizontal electric field. A number of runs was made with Li_2CO_3 solution. The Li^7/Li^6 ratio was found to be decreased in the cathode columns and increased in the anode columns. (D.L.C.)

22073 CONCENTRATION OF SILICON ISOTOPES Si^{29} AND Si^{30} THROUGH DISTILLATION OF METHYLSILANE. R. Brunken and W. Jost. Nachr. Akad. Wiss. Goettingen, II, Math.-Physik. Kl., No. 4, 123-6(1962). (In German)

An experimental investigation was made of the separation of Si^{29} and Si^{30} by the distillation of CH_3SiH_3. A separation column filled with wire spirals and having an effective separation length of 1 meter was used. The CH_3SiH_3 samples taken for isotopic determinations were converted to SiF_4 prior to mass spectrometric measurements. The data are plotted on a concentration ratio vs time graph, for ratios between head and bubble, head and natural occurrence, and bubble and natural occurrence, and it is seen that the heavier isotope Si^{30} is enriched in the gas phase. The concentration ratio between head and bubbles after nearly 10 days is 1.025 for Si^{30} and 1.013 for Si^{29} for a reflux rate of 60. From the estimated value of 50 theoretical plates for the column efficiency, a separation factor of 1.0007 for Si^{30} and 1.00035 for Si^{29} is obtained. (D.L.C.)

22074 ELECTROLYTIC SEPARATION OF DEUTERIUM; EFFECT OF TEMPERATURE. M. S. Raman, R. Kumar, and R. L. Datta (Indian Inst. of Science, Bangalore, India). Z. Naturforsch., 18a: 347-50(Mar. 1963). (In English)

The effects of cathode material and temperature on the separation factor in the electrolytic enrichment of deuterium were investigated in the temperature range 30 to 60°C. Mild steel cathodes gave separation factors higher than those for nickel, silver, platinum and tin, whereas an alloy of mild steel +7.85% tin gave still higher separation factors. The temperature coefficient of the separation factor ($d\alpha/dT$) for cathodes of tin and for an alloy of mild steel + tin (62.3%) was positive, whereas for other cathodes studied, $d\alpha/dT$ was negative. The temperature dependence of the separation factor was decreased by alloying mild steel with tin. It became zero for the alloy with 39.5% tin. (auth)

22075 DI-TEMPERATURE EXCHANGE OF DEUTERIUM IN THE SYSTEM WATER–HYDROGEN CHLORIDE. S. E. Vaisberg, Ya. M. Varshavskii (Karpov Inst. of Physics and Chemistry). Zh. Fiz. Khim., 37: 307-9(Feb. 1963). (In Russian)

Experiments on the dual-temperature isotopic separation of hydrogen were carried out in counter-current columns with the system hydrochloric acid–gas-vapor mixture of hydrogen chloride and water. The two component state of the phases may lead to a shift in the enrichment peak to beyond the current ratio λ, equal to the partition factor α of deuterium. Maximum enrichment in the given system at column temperatures of t = 17° and t′ = 90° corresponded to $\lambda = 2.7$ to 2.9, whereas $\alpha_{17°} = 2.53$. The ratio φ between the exchange in rectification of water and the dual-temperature isotopic exchange was found equal to 0.4. (auth)

22076 METHOD FOR ENRICHING DEUTERIUM IN DEUTERIUM–HYDROGEN MIXTURES BY PREFERENTIAL ADSORPTION AND DESORPTION USING PALLADIUM AS ADSORBENT. U. Schmieschek. German Patent DAS 1,143,792. Feb. 21, 1963. Filed Nov. 10, 1959.

The method described is for preparing a mixture of hydrogen isotopes which is enriched in deuterium. It is based on the knowledge that when employing palladium for adsorbent the deuterium isn't enriched in the remaining gas but in the palladium. Palladium or palladium alloys in the form of sheets or wires are applied as adsorbent, and the desorption is facilitated by heating these sheets or wires electrically. (Gmelin Inst.)

22077 METHOD FOR ENRICHMENT OF DEUTERIUM BY DEUTERIUM EXCHANGE BETWEEN A FLUID WATERY PHASE AND A VAPOR PHASE, THE TWO PHASES

BEING IN THERMODYNAMIC EQUILIBRIUM. K. Wetzel (to VEB Vakutronik). German Patent DAS 1,144,697. Mar. 7, 1963. Filed Dec. 22, 1959.

The method for enrichment of deuterium by deuterium exchange between a fluid watery phase and a vapor phase comprises the step of generating a counter current between a fluid medium and a vapor which is in thermodynamic equilibrium with the fluid. The counter current is established in a distillation column. The fluid is a mixture of azotic acid or perchloric acid and water. The mixture which is enriched with deuterium is gathered from the head of the column. (Gmelin Inst.)

MATHEMATICS AND COMPUTERS

Refer also to abstract 22800.

22078 (CERN-63-7) A COMPUTER PROGRAMME FOR THE SOLUTION OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS (POTENTIAL PROBLEMS). J. S. Hornsby (European Organization for Nuclear Research, Geneva). Mar. 26, 1963. 44p.

A computer program is presented which is designed to set up approximate difference equations for solution of a net that is superimposed on regions of interest in applied mathematical analysis of cylindrical symmetry problems where the boundary of the region is curved. (J.R.D.)

22079 (HW-71044) CIRCUITS FOR MANUAL ENTRY OF DATA INTO A MULTICHANNEL ANALYZER MEMORY. G. E. Driver (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 13, 1961. Contract AT(45-1)-1350. 19p.

A device was developed to add digital data to pulse-height spectra information read out from Hanford's whole-body counter. The pulse-height data are stored in a magnetic-core memory of a pulse-height analyzer. Pulse height and digital data are entered into the counter's memory unit through a keyboard similar to that of a five-column adding machine. (auth)

22080 (ISS-63/2) PROGRAMMA PER IL CALCOLO DELLE RADICI TERZA E QUINTA DI UN NUMERO, COL METODO DI NEWTON (CALCOLATORE ELETTRONICO IBM 610). (Program for Calculating the Cubic and Fifth Roots of a Number of Newton's Method (610 IBM Electronic Computer)). D. Giucci (Italy. Istituto Superiore di Sanità, Rome). Jan. 3, 1963. 22p.

A program was devised for calculating the cubic and fifth roots of a number of Newton's method using the 610 IBM electronic computer. For convenience a program was added for obtaining n^{th} roots by the logarithmic method. (auth)

22081 (ORNL-3428) AN IBM-7090 SUBROUTINE PACKAGE FOR LAGRANGIAN INTERPOLATION. S. K. Penny and M. B. Emmett (Oak Ridge National Lab., Tenn.). May 16, 1963. Contract W-7405-eng-26. 9p.

A FORTRAN subroutine was written for the purpose of generating a table of data by Lagrangian interpolation in a smaller table of data. There are three options for the interpolation scheme: linear, semilog, and log-log. The number of points to be used in the Lagrangian interpolation is optional. This subroutine provides information for a table lookup, which is usually much less costly than direct computation. (auth)

22082 (SCR-483) TABLES OF THE DISTRIBUTION OF THE COEFFICIENT OF COHERENCE FOR STATIONARY BIVARIATE GAUSSIAN PROCESSES. D. E. Amos and L. H. Koopmans (Sandia Corp., Albuquerque, N. Mex.). Mar. 1963. Contract [AT(29-1)-789]. 327p.

The modulus $\gamma^{(\lambda)}$, called the coefficient of coherence, is examined, and coherence is redefined for weakly stationary, bivariate stochastic processes. The coefficient is interpreted in this new setting, and examples in which the coefficient occurs as a parameter of interest are presented. The stochastic process is then assumed to be Gaussian, and the approximate distribution of an estimate of the coefficient is considered. Formulas and approximations used in calculations of the coefficient are given; use of the tables is demonstrated; and methods of experimental design are treated. The tables give the probability density function, the cumulative distribution function, the mean, and the variance of the coefficient of coherence. (D.C.W.)

22083 (TID-18478) TECHNICAL PROGRESS REPORT. PART I. HIGH SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. SWITCHING THEORY. PART IV. MATHEMATICS. PART V. IBM 7090-1401 SYSTEM. PART VI. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). February 1963. Contract AT(11-1)-415. 51p.

The status of all computer development and mathematics research programs is summarized. (J.R.D.)

22084 ON THE REPRESENTATIONS OF THE SEMI-SIMPLE LIE GROUPS. I. THE EXPLICIT CONSTRUCTION OF INVARIANTS FOR THE UNIMODULAR UNITARY GROUP IN $\underline{N}$ DIMENSIONS. L. C. Biedenharn (Duke Univ., Durham, N. C.). J. Math. Phys. (N. Y.), 4: 436-45(Mar. 1963).

A symmetric vector-coupling coefficient for the semi-simple Lie group SU_n is defined and explicitly determined. These coefficients are utilized to construct a series of canonical invariants for SU_n, of which the first I_2 is the familiar Casimir invariant, and it is proven that these invariants form a complete system of independent invariants suitable for uniquely labeling the irreducible inequivalent representations of SU_n. (auth)

22085 AIR SAMPLE CALCULATOR (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). 1 drawing and 1 specification. (CAPE-939)

The slide rule type calculator may be used to compute concentrations of β-emitting nuclides in air in connection with a Room Air, Staplex, Moto, or impactors. It may be used for Pu or U calculations by making thoron daughter corrections. Operating and maintenance instructions are included in the specification. (F.L.S.)

22086 MULTIPLIER CIRCUIT. R. L. Chase (to U. S. Atomic Energy Commission). U. S. Patent 3,088,671. May 7, 1963.

An electronic fast multiplier circuit utilizing a transistor controlled voltage divider network is presented. The multiplier includes a stepped potentiometer in which solid state or transistor switches are substituted for mechanical wipers in order to obtain electronic switching that is extremely fast as compared to the usual servo-driven mechanical wipers. While this multiplier circuit operates as an approximation and in steps to obtain a voltage that is the product of two input voltages, any desired degree of accuracy can be obtained with the proper number of increments and adjustment of parameters. (AEC)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstracts 21810, 22785, 22852, 22855, 22928, 22929, 22931, 22932, 22933, 22934, 22936, 22939, 22940, and 22941.

22087 (AD-285409) EVALUATION OF THE PRODUCIBILITY OF TWO NEW TITANIUM BASE SHEET ALLOYS, Ti–7Al–12Zr AND Ti–5Al–5Zr–5Sn. Final Report, March 1, 1960–April 16, 1962. M. Scott and T. Vretas (Republic Steel Corp. Titanium Research Lab., Canton, Ohio). Apr. 16, 1962. Contract NOas 60-6035-C. 99p.

The commercial feasibility of producing Ti sheet from two new alpha-type alloys, Ti–7Al–12Zr and Ti–5Al–5Zr–5Sn, was investigated. Two-hundred-pound ingots were double vacuum melted and converted to sheet product for both analyses. Optimum finish hot rolling temperatures were determined as 1750°F for both alloy types. Processing and testing of the sheet showed that the Ti–7Al–12Zr composition develops metallurgical instability as evidenced by bend properties and tensile ductility. This condition was not evident for the Ti–5Al–5Zr–5Sn alloy. (auth)

22088 (BM-RI-6226) ELECTROWINNING URANIUM FROM URANIUM OXIDE. D. G. Kesterke, L. W. Schramm, R. G. Knickerbocker, and T. A. Henrie (Bureau of Mines. Reno Metallurgy Research Center, Nev.). Oct. 1962. 13p.

The electrolytic reduction of UO_2 to molten U in fluoride baths at approximately 1200°C was demonstrated. Electrolyte constituents were BaF_2, UF_4, and either MgF_2 or LiF. Preliminary laboratory-scale experiments were made in which the UO_2 was added continuously for 3 to 5 hr to the cell during electrolysis. Over 1000 g of metal of 99.8% purity was made in some tests. Major impurities were Al, Ba, Fe, Si, C, and O. The effects of cell design, geometry, and bath composition were investigated. Electrode arrangement was the most important factor in cell performance. (auth)

22089 (BRB-72) QUARTERLY PROGRESS SUMMARY, JULY–SEPTEMBER 1962. (Bridgeport Brass Co., Seymour, Conn.). Apr. 9, 1963. Contract AT(30-1)-1405. 36p.

A feasibility study was conducted on electrochemical machining of U. This process appears to warrant further investigation for use in drilling, machining, and sawing operations on U. An experiment was conducted on the beta heat treatment procedures for extrusion billets which indicated possible shortening of heating times and lessening of the number of cycles. An investigation which was part of the program to evaluate temperature sensing instruments at 800 to 1200°F is described. One instrument was obtained for further investigation. A series of DYNAPAK extrusion experiments were conducted to establish procedures for the extrusion of I & E fuel elements. Results indicate the feasibility of the process. X-ray studies were conducted to determine additional technical data on Mark V-B production. These data, in conjunction with other characteristic data, will be used as a basis for the quality control program. (auth)

22090 (CEA-2256) EQUIPEMENT DE LA CELLULE DE METALLORGAPHIE NO. 10 DU L.E.C.I. (Equipment of the Metallographic Cell No. 10 in the Irradiated Fuel Element Laboratories (L.E.C.I.). E. Roussel and N. Vignesoult (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 23p.

A conventional metallographic apparatus was adapted for work in a protected cell. The small size of the apparatus facilitates repairing it on a work bench which can easily be dismantled. Ease of decontamination is another feature of the apparatus. (auth)

22091 (GAMD-1130) CREEP SHRINK PROCESS-APPLICATION TO MGCR FUEL ELEMENT. R. W. Bean (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 17, 1959. Contract AT(04-3)-187. 40p.

The results of a preliminary theoretical analysis of the structural performance of the MGCR heterogeneous fuel element sheath are presented. A method for prestressing the sheath in the circumferential direction is examined together with the effect of the prestress condition on subsequent performance under reactor conditions. The analysis is applied to three candidate sheath materials in order to obtain comparative data. (auth)

22092 (GE63FPD66) ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS. VOLUME II. MATERIALS SUPPORT. Final Report, January 1, 1961 to June 30, 1962. J. W. Semmel, Jr., W. R. Young, and W. H. Kearns (General Electric Co. Spacecraft Dept., Cincinnati). Jan. 14, 1963. Contract NAS 5-681. 196p.

Materials support was provided for alkali metals boiling and condensing investigations that required the construction of a 300 kw heat transfer loop from L-605 and a 100 kw loop from the Cb–1 Zr alloy. In addition to the preparation of specifications for these materials and assistance in constructing the heat transfer facilities, experimental investigations were conducted to document several aspects of the materials behavior that were pertinent to the loop construction and operation. Experimental work was performed in the following areas: oxidation of L-605 in air and combustion gas, compatibility of L-605 with ceramic insulation materials, grain growth in bent L-605 tubing, aging and embrittlement of L-605, corrosion of L-605 by potassium, welding L-605, joining L-605 tubing to molybdenum tubing, corrosion and diffusion bonding of Stellites No. 6 and No. 12 hard facing materials in potassium, welding Cb–1 Zr, joining Cb–1 Zr tubing to Type 316 stainless steel tubing, emittance of Cb–1 Zr and LB-2 and TiO_2–Al_2O_3 coatings applied to Cb–1 Zr, spraying alumina and molybdenum on to Cb–1 Zr tubing to form a resistance heating element, and joining tantalum to alumina by brazing and diffusion bonding. (auth)

22093 (GEMP-21A) HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 21, Part A, Jan. 1, 1963 to Feb. 15, 1963. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 23, 1963. Contract AT(40-1)-2847. 35p.

Several creep-rupture stands which were used in the high-temperature alloy program are being modified for testing the refractory metals in an inert atmosphere. A test program to study the effects of irradiation on the refractory metals was established. Test specimens were fabricated with material on hand. Some preliminary irradiations and post-irradiation testing of tungsten and molybdenum were completed. Reactor time is being scheduled

for the first phase of the refractory metals specimen irradiations. The remaining experiments required to complete the high-temperature alloy irradiations effects study were delineated. Structure studies are also continuing on this phase of the program. The damage patterns in body-centered cubic systems are being studied with the use of high-speed electronic computers. The stress-rupture testing of molybdenum in hydrogen and argon at 2200°C was extended from 10 to 100 hours. Data obtained from the 100-hour tests are in agreement with values obtained by linearly extrapolating the data from the 10-hour life tests. The creep rates determined from these lower-stress, longer-life tests are consistent with those determined from the higher-stress, shorter-life tests. The Larson-Miller constant was determined for the molybdenum data at 2200 and 2400°C. These data compare well with that of other investigators working at 870, 980, and 1100°C. The mechanical property testing in neon previously planned was delayed. (auth)

22094 (HW-71023) HEAT TREATMENT, TENSILE PROPERTIES, AND CORROSION RESISTANCE OF Zr-2a/o Nb-2a/o Sn ALLOY. J. J. Holmes (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 22, 1961. Contract AT(45-1)-1350. 24p.

Results of a study concerning the heat treatment, tensile properties, and aqueous corrosion of Zr–2 at.% Nb–2 at.% Sn alloy are presented. (J.R.D.)

22095 (MAB-192-M) EVALUATION TEST METHODS FOR REFRACTORY METAL SHEET MATERIAL. (National Research Council. Materials Advisory Board). Apr. 22, 1963. 44p.

Procedures and standards for evaluation of refractory metal sheet material are outlined. Determinations of physical properties as well as tests of mechanical properties are included. Some flexibility in test procedures should be understood provided the test objective is met satisfactorily. All deviations from the recommended test methods should be clearly stated and justified. A report form is included to provide a uniform format for this purpose. (P.C.H.)

22096 (NMI-7218-2) EVALUATION OF FIFTEEN OUTER TUBES OF ZIRCALOY-CLAD UNALLOYED URANIUM FOR THE HWCTR. A. B. Bremer (Nuclear Metals, Inc., Concord, Mass.). Aug. 1, 1962. Contract AT(30-1)-1565. 36p.

The design for HWCTR metal fuel elements provides for a nested pair of inner and outer thin-walled tubes. Data obtained in an evaluation of 15 Zircaloy-clad unalloyed U outer tubes coextruded with integral Zr end seals show that all tubes met specifications. The test data are included. (J.R.D.)

22097 (NP-12722) GRUNDLAGEN DER METALLHERSTELLUNG DURCH DRUCKAUFSCHLUSS UND DRUCKREDUKTION. (Fundamentals of Metal Production by Pressure Decomposition and Pressure Reduction (thesis)). Johannes Gerlach (Berlin. Technische Universität). Feb. 14, 1962. 81p.

After a general consideration of the thermodynamic and critical fundamentals of the pressure leaching and the pressure precipitation, the kinetic investigation of the pressure leaching of metals from oxide and sulfide minerals is reported. A literature survey on leaching in acid and ammonia solutions is presented. The pressure precipitation of copper, silver, mercury, or bismuth salts with hydrogen, carbon monoxide, or sulfur dioxide proceeded as homogeneous reactions in the solution, while the preparation of metallic nickel or cobalt powders was carried out by pressure reduction in a heterogeneous reaction on crystallization nuclei. As nuclei, mostly fine metallic nickel or cobalt powders were used. For pressure reduction of uranyl salts as well as vanadates, metallic nickel powder was also necessary as nuclei binder. The reduction rate is influenced by kinetic factors, which must be determined for each reaction. Some technological processes for metal production by pressure decomposition and pressure reduction are described. (M.C.G.)

22098 (SB-62-22) BERYLLIUM: AN ANNOTATED BIBLIOGRAPHY, JULY–SEPTEMBER 1962. SUPPLEMENT II. Jack B. Goldmann, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Dec. 1962. Contract NOrd-17017. 61p.

References (140) on analysis, alloys, applications, compounds, corrosion, fabrication, joining, mineralogy, oxides, powder metallurgy and casting, processing, and properties of beryllium are given to reports, U. S. and foreign journals, and patents released during the third quarter of 1962. (P.C.H.)

22099 (SB-62-64) EMBEDDING MATERIALS FOR MODULAR ASSEMBLIES: A PARTIALLY ANNOTATED BIBLIOGRAPHY. C. M. Pierce, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Mar. 1963. Contract NOrd 17017. 94p.

References (211) are given to journals, reports, and books published from 1950 through June 1962 on materials that can be used for the embedding of electronics assemblies. Separate corporate author, personal author, and subject indexes are included. (P.C.H.)

22100 (TID-18523) SPECIFICATION FOR APPLICATION OF VINYL COATINGS TO METAL. C. H. Henager (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 8, 1961. Contract [AT (45-1)-1350]. 6p. (HWS-5963)

Specifications for application of chemical resistant vinyl coating systems to Fe, steel, Al, brass, and Cu surfaces are presented. (J.R.D.)

22101 (WAL-TR-420.5/1) EVALUATION OF CO-REDUCED DEPLETED URANIUM ALLOY. Ernest N. Kinas and F. J. Rizzitano (Watertown Arsenal, Mass.). Mar. 1963. 10p. (AD-401158)

Two alloys, U–8% Mo and U–8% Mo–1% Ti, were investigated to determine the advantage of forging depleted U components directly from co-reduced dingot stock. Some of the co-reduced dingot stock was remelted into ingots and was hot worked in the same manner as the material from the dingot. Mechanical properties were obtained to determine the effect of both methods. Photos were obtained to compare the effect of different processing methods and heat treatments on metallurgical structure. The hot-working methods used were upset forging and cogging. Data obtained indicated that co-reduced material could be forged and heat treated directly to give good combinations of mechanical properties. Remelting of co-reduced hot working material followed by hot working resulted in only slightly higher yield strength. (auth)

22102 (WAL-TR-851.5/1) AN ANALYSIS OF CARBON CRYSTALLITE GROWTH KINETICS DURING GRAPHITIZATION. Aram Tarpinian and Craig Tedmon (Watertown Arsenal Labs., Mass.). Nov. 1962. 16p.

An analysis was made of the growth kinetics of carbon crystallites during annealing of a petroleum coke through the range of 2057 to 2727°C. A single activation energy of 90 kcal/mole was found for the growth process. (auth)

22103 (AERE-Trans-931) THE ARC-PLASMA BURNER. A NEW FORM OF HIGH-TEMPERATURE HEAT SOURCE. F. Wendler. Translated by W. G. Stripp from Elektrotech. Z., 83A: 773-6(1962). 10p.

The principles of the direct (transferred) and the so-called indirect (non-transferred) plasma burner are described, and the applications of various gases as plasma-forming working gases are discussed. In addition to the generation of very high temperatures (more than 10,000°K), very high jet velocities can be achieved with the plasma beam (supersonic). This new form of heat source will be used with advantage where materials with high melting points or chemical sensitivity have to be subjected to heat treatment. 23 references. (auth)

22104 (EURAEC-373) DEVELOPMENT OF PROCESSES FOR THE PREPARATION OF URANIUM CARBIDES AS WELL AS CERMETS ON UC BASE. Final Report No. 1, April 1, 1960–April 1, 1961. (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 012-60-5RAD. 17p. A translation.

Preparation of UC based on a reaction between powders of UO_2 and graphite are reported. In this connection particular stress was laid on obtaining stoichiometric UC with a C content of 4.8 ± 0.1% by weight. It was possible to keep within these limits if the overstoichiometric O_2 content of the UO_2 was taken into consideration when weighing the powder intended for the mixture corresponding to the formula $UO_{2+X} + (3 + X)\,C \rightarrow UC + (2 + X)\,CO$. The powder mixture was converted into UC either in the solid state at 600°C under vacuum or by melting in the electric arc under Ar. The UC tablets prepared by reaction in the solid state have a density of 8 g/cm^3 (theoretical density 13.63 g/cm^3) and did not evidence an increase in weight after having been left standing a week in air. For melting the tablets on a laboratory scale, a small electric arc furnace for continuous operation was constructed, by means of which it was possible to melt about 1 kg of UC per hour. Construction of a skull melting furnace for rods was started. In view of the swaging process, fused UC was crushed to a coarse powder. This powder was stamped in V steel tubes whose diameter was subsequently reduced by 50% by swaging. After stamping, the density of the powder was 71.5% of the theoretical and was increased to 90% of theoretical by swaging. (auth)

22105 PRODUCTION OF METALLIC PROMETHIUM. F. Weigel (Universität, Munich). Angew. Chem., [75]: 1p. (May 1963). (In German)

Metallic promethium was obtained by the reduction of PmF_3 with Li in a high vacuum. As a starting material "processed promethium" from ORNL was used. The material contained about 60mg Pm^{147}, 50mg Sm, 40mg Nd, and 7mg Am^{241}. The Pm was separated by ion exchange and solvent extraction. Solutions of Pm^{3+} in HNO_3 were reacted with HF to prepare PmF_3. The PmF_3 was reacted with Li at 2.7×10^{-6} ton and 750 to 1090°C. (M.C.G.)

22106 STEELS FOR NUCLEAR POWER REACTORS. A. L. Medin (Pfaudler Permutit, Inc., Glen Burnie, Md.). Metal Progr., 83: No. 3, 109-12; 148; 150; 152-5(Mar. 1963).

Radiation effects and buildup of radioactivity in steels used in reactors are discussed, and general conclusions on the radiation effects on the mechanical properties of steels are given. The validity of accelerated tests is discussed. Steels being used in reactor pressure and containment vessels are discussed. The need of steels with improved strength for the larger pressure vessels is emphasized. The development of Cr–Mo steels for sodium reactors is discussed. The operation and results of a boiling water loop testing program on various steels are described. (D.L.C.)

22107 RADIOACTIVE CONTAMINATION OF METALLIC COPPER SURFACES WITH NON-CORROSIVE FISSION-PRODUCT SOLUTIONS. Hidehiro Goto, Shin Suzuki, and Makoto Saito (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 26: 749-54(1962). (In Japanese)

Contamination of radioactive nuclides on metallic copper surface was studied using oxygen-free sulfuric acid solution containing fission products. Experiments for the influences of various factors such as acidity of the solutions, co-existence of heavy metal ions, and cation surface-active agents, and various treatments of copper surface were carried out. The radioactive contamination of metallic copper surface in non-corrosive solution was generally less than that in corrosive solution, and copper surface was contaminated selectively by some radioactive nuclides. The radioactive contamination of copper surface was extremely decreased by addition of heavy metal ions (Fe^{3+}, Cr^{3+}) or cation surface-active agent into the solutions, and was also influenced by the condition of copper metal surface. (auth)

22108 THE PRODUCTION OF GRAPHITE COATINGS ON NUCLEAR FUEL PARTICLES ACCORDING TO A FLUIDIZED BED PROCESS. F. Benesovsky and E. Rudy (Metallwerk Plansee AG, Reutte, Tirol, Austria). Planseeber. Pulvermet., 10: 168-77(Dec. 1962). (In German)

For the production of dense graphite coatings on nuclear fuel powder particles, mainly uranium- and thorium-containing carbides, a semi-automatic high-temperature fluidized-bed apparatus on a pilot plant scale was designed. The coatings are formed by pyrolytic decomposition of hydrocarbons. The apparatus can be operated at temperatures up to 2200°C. (auth)

Corrosion

Refer also to abstracts 21835 and 22938.

22109 (ASD-TDR-63-160) HIGH-TEMPERATURE OXIDATION-RESISTANT COATINGS FOR TANTALUM BASE ALLOYS. L. Sama (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Jan. 1963. Contract AF33(657)-7339. 141p.

The effect of coating composition on structural changes and oxidation behavior was studied using a Sn–Al spray-slurry system with Ta, Ta alloys, Nb, W, and Mo. In tests conducted at 3000°F it was found that increased oxidation protection was most significantly related to the thickness of the Sn-rich phase at the surface. The use of refractory metal powder additives plus excess Al to form aluminide particles served best to increase the thickness of the phase. Coating composition was optimized and an extensive evaluation was carried out with Ta–10% W, Ta–30% Nb–7.5% V, and Nb–5% Zr. In oxidation tests at 1100 to over 3000°F protective life was significantly affected by substrate composition, coating thickness, and thermal cycling. Tensile and stress rupture data were obtained on coated samples at 2000 to 3000°F and correlated fairly well with data for uncoated material. Preliminary studies were made of coating stability at air pressures in the micron to millimeter range. Oxidation and diffusion

effects were explored by metallographic electron probe and x-ray analysis. A brief study of Ta–10Hf–5W in contact with Al_2O_3 at elevated temperatures showed that the alloy was unstable in contrast to pure Ta, Ta–10W, and Ta–30Nb–7.5V, which were quite stable. Oxidation data were obtained for several Ta alloys coated with Ti–Si. A diluent system was sought for beryllide-type coatings in which Sn, Cu, Si, and Ag were investigated. The use of Ag as a slurry base was found to be most promising. (auth)

22110 (BMI-1626) EFFECT OF HEAT TRANSFER ON CORROSION OF FERROUS ALLOYS IN BOILER WATERS. Warren E. Berry and Frederick W. Fink (Battelle Memorial Inst., Columbus, Ohio). Apr. 16, 1963. Contract W-7405-eng-92. 32p.

A survey was made of the effect of heat transfer on the corrosion behavior of ferrous alloys in boiler waters, particularly as applied to liquid-metal-heated steam generators. The results showed that ferrous alloy boiler tubes may fail during operation from general corrosion, O_2 pitting, on-load pitting, caustic embrittlement, chloride stress-corrosion cracking, or corrosion fatigue. All of these forms of corrosion, except on-load pitting, can be avoided by appropriate changes in design, operation, or boiler-water treatment. On-load pitting appears to be related to heat-transfer conditions, but its cause is not yet known. Heat transfer appears to affect corrosion behavior by raising the metal surface temperature, concentrating corrosive solids in the boiler water, releasing corrosion-promoting gases from solution, or providing thermal gradients in the metal and protective oxide film. Additional fundamental and applied research to define the variables and limiting conditions associated with thermal gradients as related to nucleate boiling, steam slug-flow, and thermogalvanic corrosion appears desirable. (auth)

22111 (BMI-X-229) CORROSION STUDIES IN NIOBIUM PENTAFLUORIDE. P. D. Miller, E. F. Stephan, W. N. Stiegelmeyer, and F. W. Fink (Battelle Memorial Inst., Columbus, Ohio). May 1, 1963. Contract [W-7405-eng-92]. 13p.

The corrosion resistance of "L" nickel, Monel, and INOR-8 to NbF_5 under refluxing conditions was investigated. A thin deposit of Cu on submerged portions indicated incomplete immunity of Monel. No obvious damage occurred to the microstructure of the Monel as a result of the transfer of Cu. The INOR-8 specimens were very resistant to the environment and showed no intergranular effects and very little roughening. From the corrosion standpoint, Ni was rated lowest. The surface roughening at the interface was most severe in the metal, and its susceptibility to intergranular attack was also a detrimental factor. (P.C.H.)

22112 (GEAP-4165A) GENERAL AND STRESS CORROSION OF HIGH NICKEL ALLOYS IN SIMULATED SUPERHEAT REACTOR ENVIRONMENT. W. L. Pearl and G. G. Gaul (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Mar. 1963. Contract AT(04-3)-189. 46p.

This report supersedes GEAP-4165.

The results of investigations on out-of-pile general and stress corrosion of type 304 stainless steel, Inconel, Incoloy, and Hastelloy-X are presented. The performance of Inconel, Incoloy, and Hastelloy-X was acceptable under conditions that caused failures with previously tested type 304 stainless steel. The cycle test produced a type failure that can occur in a superheat reactor system but has not reproduced the most general type failure experienced in the fuel cladding exposures in the SADE facility. Under certain conditions that may exist in a superheat reactor system, oxidizing chlorides (e.g., $CuCl_2$ and $FeCl_3$) attack the materials tested to varying degrees with or without the presence of stress. (P.C.H.)

22113 (KR-39) MILD STEEL IN PRIMARY CIRCUITS IN WATER COOLED POWER REACTORS. Ketil Videm and Steinar Aas (Norway. Institutt for Atomenergi, Kjeller). Feb. 1963. 24p.

Corrosion of mild steel in water of different qualities is reviewed. The corrosion rate in hydrogenated water at pH 10 to 11 is 40 mg Fe/dm^2-month or lower after an extended conditioning period. When pH is reduced the rate is increased and the products appear in a more unsuitable form from a purification point of view. Oxygen and hydrogen contents normally experienced in boiling water reactors appear to result in the lowest corrosion rates observed when the water is neutral. An evaluation of the release rates of corrosion products and the expected activity level, compared with the figures observed in stainless steel systems, indicate that a mild steel circuit should not give rise to particularly difficult purification problems. All considered, the boiling system with neutral water appears to be the most promising one in as much as purification and water monitoring costs would be about the same as those for a stainless steel system. If necessary the oxygen level in a boiling water reactor can be kept at fairly low values. (auth)

22114 (EURAEC-557) QUARTERLY REPORT NO. 2 [ON STAINLESS STEELS], OCTOBER 1–DECEMBER 31, 1962. G. Chaudron ([France. Centre National de la Recherche Scientifique, Paris]). Work Performed under United States–Euratom Joint Research and Development Program. Contract 085-62-7-RDF. 33p. A translation.

Analyses of steel were made for carbon, oxygen, and nitrogen. The methods and apparatus used for the determinations are given, and the results are tabulated. Investigations were also made on the weight loss of stainless steel in 6 N HCl and pitting corrosion in solutions of sodium bicarbonate with addition of sodium chloride. Different grades of steel showed differences of behavior in HCl and also in sodium carbonate solutions. (P.C.H.)

22115 (EURAEC-559) STUDY OF SOME PROBLEMS OF METAL OXIDATION AND APPLICATION OF IMPEDANCE MEASURING METHODS TO THE STUDY OF CORROSION RESISTANCE IN AN AQUEOUS MEDIUM. Report No. 3. Quarterly Report No. 4, October 1–December 31, 1962. (Brussels. Université). Work Performed under United States–Euratom Joint Research and Development Program. Contract 081-62-5RDB. 19p. A translation.

The capacity-tension curve of the gold electrode in a 1M KCl medium is shown. Contamination effects on differential capacity-tension curves were studied. The capacity behavior of gold and platinum under tensions at which oxidation takes place was studied. Coulometric behavior was also investigated. (M.C.G.)

22116 (EURAEC-573) GALVANIC ACTIONS BETWEEN CARBON STEEL AND ALLOY STEEL OR ALUMINUM. Report S5. (Brussels. Centre Belge d'Etude de la Corrosion). Dec. 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 006-60-3-RDB. 44p. A translation.

A study was made concerning the influence of galvanic action on the behavior of carbon steel boiler grade) in the presence of water of a fair degree of purity, at about 20°C. The study was based mainly on the measurement and in-

terpretation of electrode voltages and electric currents resulting from galvanic actions. It was found that when coupling is effected with 99.5% Al, the behavior of both metals varies considerably according to whether the Al is aerated or not. If the Al is not aerated, it undergoes a sacrificial corrosion that gives rise to a cathode protection of the carbon steel. If the Al is aerated, the metal is only slightly corroded and does not greatly affect the behavior of the carbon steel. Coupling with AISI 304 stainless steel hardly affects the behavior of the carbon steel if oxygen is totally absent. A differential aeration of the stainless steel leads to a much stronger corrosion of the carbon steel. In either case, the stainless steel remains almost free of corrosion. In a general way, the rate at which the carbon steel corrodes in various coupling and aeration conditions is largely dependent on the electrode voltage that steel exhibits in those conditions. (P.C.H.)

22117 MECHANICAL PROPERTIES AND CORROSION RESISTANCE OF HAFNIUM–ZIRCONIUM ALLOYS IN STEAM–WATER MEDIA. R. V. Grebennikov and F. P. Shamashov. At. Energ. (USSR), 14: 290-5(Mar. 1963). (In Russian)

Because of its excellent corrosion resistance in water up to 360°C and in superheated steam up to 400°C, Hf found uses as structural material in reactor technology; e.g., it was used in the Nautilus control rods. In order to reduce the cost of fabricating these components, the corrosion resistance of Hf alloys containing up to 50% Zr was investigated. The corrosion tests were carried out in a 6-cm^3 stainless steel container with water at 350°C and with water–steam mixtures at temperatures ranging from 400 to 450°C. The Hf alloys, containing 2 to 5, 25, 30, and 50% Zr were tested both in the annealed and the cold-worked condition. The mechanical properties of alloys were determined at 20°C before and after the corrosion testing. The results indicated that the alloys containing up to 30% Zr possess high corrosion resistance against water at 350°C. The mechanical strength decreased somewhat as the Zr content was raised from 3 to 25%. Extended exposure to water–steam mixture at 400° did not cause a marked deterioration of the physical properties of the Hf–3% Zr alloy. Thus, Hf alloys containing up to 30% Zr are recommended for use in contact with water at 350°C. (TTT)

22118 EFFECT OF SOLUTION HEAT TREATMENT ON CORROSION KINETICS OF ZIRCONIUM IN 20 PERCENT HYDROCHLORIC ACID AT HIGH TEMPERATURE AND PRESSURE. William E. Kuhn (Carborundum Co., Niagara Falls, N. Y.). Corrosion, 19: 169t-79t(May 1963).

An investigation was made of the influence of amount and distribution of precipitate phase on the corrosion kinetics of "low purity" zirconium in 20% hydrochloric acid at 200°C. It was found that minimum corrosion rates, coincident with minimum values of activation energy and frequency factor in the Arrhenius relationship, were obtained by solution heat treatment at 700°C followed by water quenching. Such heat treatment gave a corrosion rate equivalent to that of alpha-annealed iodide zirconium. A maximum corrosion rate was obtained by a beta solution treatment at 890°C followed by water quenching, whereas beta solution treatment at 1000°C gave sharply reduced corrosion rates. Nature of distribution of the precipitate phase profoundly influenced corrosion rate. A discontinuous pattern of intergranular and transgranular globular particles was substantially less deleterious than the same amount of impurity phase finely disseminated throughout the microstructure. The results of the investigation are discussed in terms of the possible roles of chlorine and hydroxyl ions in the corrosion mechanism. Relative effects on corrosion kinetics of statistical distributions of active sites (each characteristic of lattice configurations produced by lattice defects, solute atoms and precipitation phenomena) are also considered. (auth)

22119 EFFECT OF DRY STEAM ON INTERMEDIATES HAVING A BASE OF Al–Fe–Ni. J. Moisan, P. Lelong, and J. Hérenguel (Société Tréfimétaux, Centre de Recherches, Antony, France). Corrosion Anti-Corrosion, 11: 13-24(Jan. 1963). (In French)

Alloys of aluminum with 1% Fe and 1% Ni are slightly and uniformly corroded by water or saturated steam. Passing the critical point does not lead to an appreciable change of the mechanism and the attack kinetics. However, near 400°C and chiefly above 430°C very severe pits appear after a relatively short, but very variable, time. The fissures and overlap boundaries seem favorable to the appearance of this type of attack. The modes of penetration are studied as a function of the nature and structure of the samples and of various exposure conditions. Some intermediates obtained by fritting-extrusion support the action of the vapor up to 450°C. (tr-auth)

22120 APPLICATION OF MASS SPECTROMETRY TO THE STUDY OF CORROSION. A. P. Van Peteghem and G. Vanderkelen (Université, Ghent). Corrosion Anti-Corrosion, 11: 41-8(Feb. 1963). (In French)

During investigations on corrosion phenomena, it was concluded that some chemical products (detergents, oils, glazes, and inhibitors) constitute a special danger for metals and alloys. The origin of this danger appears to be in sorption phenomena. Therefore, it should be possible to monitor sorption by the analysis of gases adsorbed or liquids absorbed. Mass spectrometry, indicated for this type of analysis, permits conclusive results to be obtained. (tr-auth)

22121 CORROSION OF IRON BY URANIUM HEXAFLUORIDE. J. Dixmier, L. M. Vincent, and R. Hasson (Commissariat a l'Energie Atomique, Saclay, France). Corrosion Anti-Corrosion, 11: 86-97(Mar. 1963). (In French)

Corrosion by UF_6, utilized for the isotopic enrichment of uranium, is a gas–metal reaction possessing many analogies with dry oxidation. It differs, particularly, by the fact that at the interface formed during the reaction, the sub-fluorides of uranium, solid residues of the UF_6 molecule, usually come into play. In the presence of moist air, these can be hydrolyzed with a release of HF which causes post-operative corrosion figures. The tests were made on iron of commercial purity. There is formation of interferential films and of corrosion centers growing by lateral extension. The corrosion aspects correspond, according to the temperature, to preferential attack of inclusions, to attack of the grain boundary, or to attack of micropits in the ferrite grains. The importance of the micropits varies with the crystalline orientation. The different corrosion processes are strongly affected by the method of preparation of the surfaces, and some of these processes recall the germination phenomena of oxides or sulfides. (tr-auth)

22122 ON THE OXIDATION OF SOME BINARY NIOBIUM-BASE ALLOYS. D. A. Prokoshkin and E. V. Vasil'eva. Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met., 9: 164-71(1962).

The influence of Ti, V, Cr, Si, Ta, Mo, W, Al, and B on the resistance of Nb alloys to scale formation was investigated by determining the weight increase in samples after they had been heated in the air for 1, 2, 3, 5, and 10 hr at 1000, 1100, 1200, and 1300°F. X-ray analysis of the scale was then conducted. The results show that the alloying of Nb leads to a change in the diffusion of O through the scale formed, to the formation of new phases in the scale, and to changes in the plastic properties of the scale. Alloying also changes the crystal parameters of the scale and of the adjacent layers. Investigations on ternary and more complex Nb-base alloys are also discussed. (P.C.H.)

22123 ATMOSPHERIC CORROSION BY ELECTROLYTE NUCLEI. B. Sanyal and D. V. Bhandwar (Defense Research Lab., Kanpur, India). J. Sci. Ind. Res. (India), 21D: 243-8(July 1962).

The influence of humidity, temperature, period of exposure, and quantity of electrolytes on the rates of corrosion of a number of metals by some representative electrolytes and their mixtures was studied. The salts used were sodium chloride, sodium sulfate, ammonium chloride, and ammonium sulfate. The atmospheric corrosion of mild steel, Al, Cu, Zn, brass, Sn-plate, galvanized Fe, and Pb by the electrolytes, representing the corrosive constituents of metal treatment materials likely to be left as residues on metal surfaces, was investigated under controlled conditions. A new technique was developed for inoculating the metal surfaces with the electrolyte nuclei. The corrosion rates were, in general, in the descending order: mild steel, galvanized Fe, Zn, Cu, brass, tinplate, Pb, Al; only the first 4 though, undergo appreciable corrosion. The chlorides are more corrosive than the sulfates. Corrosion rates increase with increase in humidity, temperature, period of exposure and concentration of electrolyte on the metal surface. Corrosion is also influenced by the pH of the solution used for inoculating the metal surfaces. In the case of mixtures of electrolytes, the total effect is additive. Increased supply of oxygen is the main factor contributing to enhanced corrosion. (TCO)

22124 THE EFFECT OF CORROSION CONDITIONS ON THE STRESS-CORROSION CRACKING BEHAVIOR OF Al–Zn–Mg 3%. W. Gruhl (Vereinigte-Leichtmetall-Werke GmbH, Bonn). Metall, 17: 197-201(Mar. 1963). (In German)

The stress-corrosion cracking behavior of Al–Zn–Mg samples, which were brought to a very sensitive state by unsuitable heat treatment, was studied in various corrosive solutions with a NaCl base. It was found that stress-corrosion fractures occur in all the media studied and in pure, completely salt-free water. An extensive preliminary corrosion without stress in neutral boiling salt solution leads to very short lifetimes when the contact of the sample with the corrosion agent is not interrupted. Dilution of the corroding agent gives longer lifetimes at low stresses. In the acid range a decrease of the pH value leads to a shortening of the lifetime. A significant delay of the stress-corrosion cracking occurs in weakly alkaline solutions, but fractures still occur at high pH values. Additions of Cu and Fe chloride shortened the lifetime. Additions of Na_2CrO_4, Na_2PO_3, and Na_2SO_3 do not alter the stress-corrosion behavior. The results are in agreement with earlier results and it was concluded that the stress-corrosion process is multistaged. The strength of the corrosion medium generally affects only the preparatory period. (tr-auth)

22125 FORMATION AND STRUCTURE OF SURFACE LAYERS ON INDIUM–LEAD AND IRON–NICKEL ALLOYS DURING THE CORROSION PROCESS. N. N. Gratsianskii, I. D. Vdovenko, and N. L. Baturins'ka (Baturinskaya) (Public Inst. of Inorganic Chemistry, Kiev). Ukr. Fiz. Zh., 7: 1118-24(Jan. 1963). (In Ukrainian)

The surface layers on indium-lead and iron-nickel alloys were studied by the method of roentgenographic analysis. As a result of the investigation it was found that, after corrosion in a sulfuric acid solution, a corrosion layer, consisting almost entirely of pure lead and a solid solution rich in lead, is formed on the surface of resistant indium-lead alloys. A thicker layer of solid solution, enriched with lead, is formed on non-resistant alloys. A typical feature of the formation of surface layers during corrosion of indium-lead alloys is the change in crystal dispersity due to collective or surface recrystallization. This results from the fact that when the unstable component is dissolved, the alloy structure becomes loose, and the remaining atoms of the stable component possess an augmented reserve of free energy; with a definite thickness of these atoms, this leads to their regrouping and the formation of a structure with a stabler state. Among the basic factors affecting the corrosion resistance of solid solutions is the composition and structure of the forming surface layer. (auth)

Fabrication

Refer also to abstracts 22808, 22924, 22925, 22926, and 22930.

22126 (AD-402406) INVESTIGATION OF ULTRASONIC WELDING OF REFRACTORY METALS AND ALLOYS. Bimonthly Progress Report No. 3, December 16, 1962–February 15, 1963. (Aeroprojects, Inc., West Chester, Penna.). Mar. 1963. Contract NOw-63-0125-c. 15p.

Both power and clamping force associated with ultrasonic welding were successfully programmed. By means of a servo-controlled hydraulic valve in the clamping force system, inadequate force response times were improved and are now adequate for carrying out the projected welding of refractory metals with the improved technique. Tentative specifications for refractory metals of reasonably satisfactory quality were also established. (auth)

22127 (ASD-TDR-63-296) VACUUM ARC MELTING OF TUNGSTEN + 0.6 COLUMBIUM. George A. Reimann (Westinghouse Electric Corp., Blairsville, Penna.). Apr. 1963. Contract AF33(616)-7459. 84p.

Vacuum arc melting techniques were developed to produce sound 3½-in. and 4-in. dia. ingots of W base alloys. The effect of melting rate on ingot characteristics was determined, and the effects of C, O_2, Zr, and Ti on melting characteristics, ingot structure, extrudability, recrystallization, and high-temperature tensile properties of the W + 0.6 Nb alloy were studied also. Refinement of ingot structure was produced by 0.06 and 0.12% Zr additions and by increasing the melting rate. Coarsening of ingot structure was produced by 0.04% Ti and 500 to 1000 ppm O_2 additions. W + 0.6 Nb ingots containing more than 50 ppm C could not be extruded, and correlation between extrudability and C content below 50 ppm was not found. Adding 0.12% Zr to the W + 0.6 Nb alloy significantly improved the 3000°F tensile properties. (auth)

22128 (DMIC-179) A GUIDE TO THE LITERATURE ON HIGH-VELOCITY METALWORKING. D. E. Strohecker and D. H. Owens (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Dec. 3, 1962. Contract AF33(616)-7747. 243p.

A guide to the literature on high-velocity metalworking is presented. Abstracts of articles, reports, books, and current research projects on and related to high-velocity metalworking are arranged according to technical subject. The reported work in the field up to about October of 1962 is covered. Abstracts of over 700 references were arranged by subject matter, with cross indexing between subjects. There is also an author index. The eleven major subjects and categories covered in the report are: energy sources, energy transfer mediums, facility requirements, tooling requirements, equipment requirements, forming, hardening, explosive welding, power compaction, metal removal, and material behavior. The references are in some cases further categorized by materials under the specific processes. (auth)

22129 (NP-12731) COLD WELDING IN A VACUUM: AN ANNOTATED BIBLIOGRAPHY. Scott J. Buginas, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Mar. 1963. 21p. (SB-63-5)

A bibliography of references on this subject, issued primarily during the years 1959 to 1962, is presented. References are in alphabetical order by author's name. (auth)

22130 (SEP-232) PREPARATION OF CORED SHAPED WIRE FOR STRUT-TYPE FUEL ELEMENTS. W. R. Weinberger and H. S. Kalish (Sylvania Electric Products Inc. Atomic Energy Div., Bayside, N. Y.). Dec. 6, 1956. Contract AT(30-1)-Gen-366. 37p.

Stainless steel–UO_2 cored wire fuel elements were studied to determine what effects, if any, might be caused by variations in UO_2 particle size, as-sintered densities, and hot swaging temperatures during the fabrication of shaped cored wire to be utilized for streamlined strut-type fuel elements. Twenty-seven assemblies were produced. Each assembly consisted of a core, produced by compacting and sintering a bar of square cross section, and machining it to a round. The core was composed of type 304 stainless steel plus 30 wt % UO_2, which was inserted into a type 304 stainless steel tube. These assemblies, about $\frac{5}{8}$ in. in diameter, were subsequently hot swaged to about 0.130 in. in diameter, and cold drawn to about 0.060 in. in diameter. They were then roll flattened and sized with shaped wire dies. An extensive evaluation of the wire was carried out during all processing stages by metallographic examination, radiographic examination and permeability checking. In this manner, effects due to variations of UO_2 particle size, hot swaging temperatures, and as-sintered densities were determined. In general, it was found that a fine UO_2 particle size (less than 44 microns) resulted in the most random UO_2 distribution. A swaging temperature of 1200°C was found to be optimum. As-sintered core material density had no effect on final density, but as the sintered density was increased, there was less tendency for the oxide particles to be broken up during fabrication. (auth)

22131 (EURAEC-516) URANIUM OXIDE EXTRUSION. Quarterly Report No. 1 (3rd Year), May 1, 1962 to July 31, 1962. (Compagnie Industrielle des Combustibles Atomiques Frittés. Corbeville, par Orsay (Seine-et-Oise), France). Work Performed under United States–Euratom Joint Research and Development Program. Contract 070-62-5 RDF. 33p. A translation.

Uranium oxide powders originating in various French and foreign facilities were extruded by a method used to obtain rods of a density above 10.4 g/cm^3. Fabrication results are reported and related to parameters such as furnace type used, reduction temperatures, and stabilizing agents. (J.R.D.)

22132 (EURAEC-525) NON-DESTRUCTIVE WELDING EXAMINATION. Quarterly Report No. 6, September 30, 1962 and December 31, 1962. (Röntgen Technische Dienst N. V., Rotterdam). Feb. 14, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 045-61-5-RDH. 9p. A translation.

Improvements made on ultrasonic equipment are discussed briefly. Time-controlled amplification was modified in such a way that elimination of the absorption effect was improved. (P.C.H.)

22133 (EURAEC-532) STUDY OF RESIDUAL STRESSES GENERATED BY THE RISING VERTICAL WELDING PROCESS. Quarterly Report No. 4, October 1 to December 31, 1962. (Arcos, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 053-61-12-RDB. 66p. A translation.

Results obtained on welding of 30- and 60-mm-thicknesses of steel to thermocouples by the Electrogas process are presented. Results were obtained on stress liberation, average stress through the thickness, penetration, surface stresses, and correction of temperature readings as a function of the precise distance from measuring points. The special drilling machine used for the determination of stresses inside the thickness, calibration of the average stress measurement apparatus according to thickness, and additional tests of the temperature measurement method are appended. (P.C.H.)

22134 (EURAEC-535) PRODUCTION OF SWAGED FUEL ELEMENTS. Quarterly Report No. 10, October 1–December 31, 1962. P. Himmelstein, W. Hoppe, H. Kroll, B. Liebmann, and C. Newmann (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 062-61-7RDD. 21p. A translation.

Melting experiments with UO_2 of well defined overstoichiometric proportions were carried out. The measured burn-off rates of the tungsten electrodes were directly proportional to the O/U ratio. With a O/U ratio of 2.00 the results were equal to those obtained in burn-off tests without any UO_2 (dummy tests). The tungsten analyses showed contents less than 50 ppm. Several apparatus for the processing of long tubes were designed and partly constructed, so that the equipment needed for making long fuel rods is almost ready. After an extension of the vibration device, it is possible to vibrate tubes up to 2 m length. By adding 20% of fine grain substance to the product resulting from the technical grinding process, densities about 85% of the theoretical density were obtained by integral use of a given amount of powder. The vibration process took 15 to 20 minutes. The hot-swaging experiments with the two-jaw machine were continued. The total cross-section reduction of 30% was obtained by means of two cold-swaged steps and one hot-swaging step at 750°C. The density obtained thereby was 92.25 ± 0.5% of theoretical density. Measurements of the density variations show that the maximum density of the UO_2 density curve is already exceeded in this reduction process. Tests were made on the sheathing tubes of the swaged rods, as well as measurements of thermal conductivity. (auth)

22135 (EURAEC-564) STAINLESS PLATINGS OF LARGE-THICKNESS STEELS. Quarterly Report No. 5, October 1 to December 30, 1962. (Ghent. Rijksuniversiteit and Soudometal, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Develop-

ment Program. Contract 040-61-9-RDB. 53p. A translation.

The effects of heat treatments on the metallography of platings are reported. Results of examinations of the mechanical, metallographic, chemical, and structural properties of samples plated by the SERIE-ARC and RUBAN processes are also reported. (J.R.D.)

22136 (EURAEC-585) RESEARCH INTO ELECTRO-SLAG WELDING OF REACTOR STEELS. Quarterly Report No. 6, October 1, 1962 to December 31, 1962. (Schweisstechnische Lehr- und Versuchanstalt, Duisburg, Germany). Jan. 31, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 046-61-3-RDA. 54p. A translation.

A basic welding powder produced from pure ingredients was found to be inferior with regard to mechanical properties to an identical welding powder in normal commercial usage, although the P and S content of the weld metal was lower. An admixture of BaO with the welding powder, as well as screening the outer surface of the pool with a flame had no effect. The use of direct current, with the wire electrode at the negative pole gives the best values. In the joint welding of low P- and S-content steel sheets (St 37-2) good values were obtained for the fatigue impact strength. Experimental welding of ASTM 302 steel sheets, quality B, with welding rods prepared at the institute showed satisfactory results and is being continued. (auth)

22137 (EURAEC-586) WELDING OF VERY THICK STEELS. Quarterly Report No. 5, October 1–December 31, 1962. (Ghent. Rijksuniversiteit and Soudometal, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 042-61-9RDB. 120p. A translation.

Research is being carried out on the welding of thick steels. Progress is reported on the analysis of O_2 and N_2 gases in welding filler materials, study of the mechanical properties of manually welded thick joints, development of an automatic welding process, perfection of artificially damped and cooled conditions, study of tenso-thermal embrittlement of filler metals during welding, studies of transformation zones in steel, Robertson tests on manual welding filler metal, and tensile cracking tests on manual welding filler metal. (M.C.G.)

22138 (EURAEC-590) USE OF PLUTONIUM AS FUEL IN THERMAL REACTORS. Special Report No. 8. (Brussels. Centre d'Étude de l'Énergie Nucléaire and Société Belge pour l'Industrie Nucléaire, Brussels). 1962. Work Performed under United States–Euratom Joint Research and Development Program. 30p. A translation. (BN-6210-09)

The use of plutonium in reactors is discussed. The work of developing oxide fuels, centered mainly on densification by vibration and swaging is described. Densities of the order of 90% can be obtained by vibration alone and increased to 94, or even 97%, by subsequent swaging. Certain important properties for the use of the fuel were also determined; for instance, the effective thermal conductivity substantially increases in relation to the temperature. Economic considerations allow selection of the method of fabrication in relation to the diameter and density of the unit. (auth)

22139 HOW TO DEPOSIT METALLIC AND NON-METALLIC COATINGS WITH THE PLASMA ARC TORCH. LeRoy W. Davis (Harvey Aluminum, Torrence, Calif.). Metal Progr., 83: No. 3, 105-8; 142; 144; 146; 147(Mar. 1963).

The high temperatures generated by the plasma flame—up to 30,000°F—permit the selection of an almost unlimited number of materials and combinations of materials for coatings and for built-up components. Examples are alumina, magnesia, beryllia, zirconia, thoria, hafnia, tungsten, and other refractory alloys, as well as carbides and nitrides of the refractory metals. (auth)

22140 WELDING AND BRAZING OF TANTALUM AND COLUMBIUM. Melvin J. Albom (Marquardt Corp., Van Nuys, Calif.). Metal Progr., 83: No. 4, 82-5(Apr. 1963).

As with tungsten and molybdenum, the inert gas, tungsten arc process—either manual or automatic—is recommended for welding tantalum and columbium. Preheating is not necessary, but careful surface preparation, good fit-up, and a protective atmosphere are important. The two metals can be brazed successfully in an inert atmosphere or vacuum. (auth)

22141 URANIUM SHEET. W. F. Biddle [(Ministry of Fuel and Power, Eng.)]. Metal Treat. Drop Forging, 30: 93-100(Mar. 1963).

The structural properties of uranium are described, and the extraction and casting of uranium for fabrication into sheets are discussed. The oxidation behavior of uranium and its effects on the fabrication processes are considered. A bibliography of 58 references is given. (D.L.C.)

22142 FURNACES, SUPPORTS AND ATMOSPHERES FOR THE SINTERING OF SOME BORIDES, NITRIDES AND SILICIDES. A. Blum (Borolite Corp., Pittsburgh). Planseeber. Pulvermet., 10: 72-7(Apr. 1962). (In English)

In the sintering of borides, nitrides, and silicides of high purity, furnace equipment, supports, and the atmospheres must be chosen so as to minimize contamination of the charge during the sintering process. This choice must be made on the basis of the thermodynamic properties of the respective materials as well as the kinetics of the reaction between the charge and the materials with which it may be in contact. Illustrations of the sintering conditions for some borides, nitrides, and silicides are given. (auth)

22143 PROPERTIES OF URANIUM PRODUCED BY EXTRUSION SINTERING. G. Cizeron and J. Peix (École Nationale Supérieure des Mines, Paris). Planseeber. Pulvermet., 10: 137-43(Dec. 1962). (In French)

Uranium prepared by the calcium-thermal method can be fabricated by hot-extrusion pressing in the α or β phase to rods of high density. The behavior of this material in the temperature change process was investigated thoroughly. By means of metallographic and dilatometric as well as density measurements before and after the temperature change, the investigation was completed. The results are different according to whether the blocks were formed in the α or β phase. (tr-auth)

22144 THE BRIQUETTING OF GRAPHITE. R. H. De Vere, (College of Tech., Letchworth, Herts, Eng.), V. Fidleris, G. M. Jenkins, and J. W. Phillips. Powder Met., No. 11, 23-41(1963).

Natural-graphite and finely ground artificial-graphite powders were subjected to improved compacting ("Shape") techniques in an attempt to produce strong, dense materials suitable for use in atomic reactors. The densities of the natural-graphite and artificial-graphite compacts were 2.18 and 2.06 g/ml, respectively; the strengths were ~2000 lb/in.^{2} in each case. Whereas "Shape" techniques improved the compact quality of briquettable materials (e.g., artificial graphite ground to 12 μ dia.), non-briquettable mate-

rials (e.g. +350 B.S. mesh artificial graphite) could not be satisfactorily compacted by any means. Compact quality was very sensitive to particle size and size distribution in the sub-sieve range. On the whole, compact density decreased with decreasing particle size, whereas the strength increased. An empirical relationship $S = KA^{\frac{1}{2}}$, between the strength (S) and the specific surface area (A) of the powder, was obtained for electro-graphite powder compacted at 10 tons/in.^{2}. Annealing these compacts at 800°C reduced their density by 1 to 2% but increased their strength by ~30%. The compacts were extremely anisotropic and experiments which were aimed at reducing this anisotropy are described. (auth)

22145 LABORATORY VACUUM HOT PRESS TO 2500°C. E. G. Wolff (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Powder Met., No. 11, 93-101 (1963).

The advantages of using vacua in the hot pressing of refractory materials are demonstrated. A simple apparatus is described which enables powders to be pressed at temperatures up to 2500°C at gas pressures of <3 μ Hg. Results with zirconium diboride (ZrB_2) show that samples of >95% theoretical density can be prepared with an impurity oxygen content of the order of 0.01 wt %. (auth)

22146 WELDABILITY AND WELDING TECHNOLOGY OF MAGNESIUM ALLOYS. B. V. Shpagin. Svarka Tsvetn. Metal. i Splavov, Sb. Statei, 30-71(1961).

The peculiarities of welding of Mg alloys, protection of Mg during the welding, reduction of the metal weld seam, difficulties during welding, general characteristic of the weldability of alloys of various systems (Mg–Mn, Mg–Al–Zn, Mg–Zn–Zr, Mn–Zr–rare earth metals), the tendency of the alloys for crack formation during welding, mechanical properties and structure of weld joints, the effect of some technological factors on the strength of the weld joint of deformable alloys, fluxes and coatings for welding, the welding technology for deformable Mg alloys, and casts in removal of defects (protective gases used and sources of current supply, preparation of the details for the welding, selection of the addition material and welding conditions, technique and technology of welding parts and casts, control, and correction of defects) are discussed. (Referativnyy zhurnal, Metallurgiya, No. 6, 1962)

22147 VACUUM COATING OF HIGH-MELTING METALS. R. A. Ul'yanov, N. D. Tarasov, and S. F. Kovtun. Tsvetn. Metal., No. 3, 74-6(Mar. 1963). (In Russian)

Experiments on Nb, Mo, and Ta coating with stainless steel (1X18H9T), Nichrome, Cr–Ni alloy (EI602), and Zr showed that increased compression improves cohesion and that higher temperatures require less compression for identical results. The structures and strengths of nickel–chromium coated Mo and Ni were not affected by 2-hour annealings at 1200°C; 10-hour annealings improved cohesion 15 to 20%. (R.V.J.)

22148 DIMENSIONALLY STABLE, CORROSION RESISTANT NUCLEAR FUEL. John Howard Kittel (to U. S. Atomic Energy Commission). U. S. Patent 3,089,768. [nd.]

A method of making a uranium alloy of improved corrosion resistance and dimensional stability is described. The alloy contains from 0–9 weight per cent of an additive of zirconium and niobium in the proportions by weight of 5 to 1½. The alloy is cold rolled, heated to two different temperatures, air-cooled, heated to a third temperature, and quenched in water. (AEC)

22149 METHOD OF BRAZING BERYLLIUM. Gale S. Hanks and Robert W. Keil (to U. S. Atomic Energy Commission). U. S. Patent 3,090,117. May 21, 1963.

A process is described for brazing beryllium metal parts by coating the beryllium with silver (65–75 wt %)–aluminum alloy using a lithium fluoride (50 wt %)–lithium chloride flux, and heating the coated joint to a temperature of about 700°C for about 10 minutes. (AEC)

Properties and Structure

Refer also to abstracts 21823, 21827, 21828, 21829, 22935, and 22937.

22150 (AD-281728) THE DEVELOPMENT AND EVALUATION OF TUNGSTEN-BASE ALLOYS. Quarterly Report No. 1, March 15, 1962 to June 15, 1962. Gordon D. McArdle, Robert Q. Barr, and M. Semchyshen (Climax Molybdenum Co. of Michigan, Detroit). Contract NOw 62-0419-c. 19p.

Binary tungsten-base alloys containing small additions of Nb, Hf, or Zr and ternary W-base alloys containing additions of Mo with Hf or Zr were consolidated by the vacuum-arc-casting process. The results of metallographic studies and hot-hardness determinations are reported. Machined blanks from each heat were extruded to round billet form at 3000 to 4260°F. Two attempts to extrude blanks from the Mo + 1% Nb alloy resulted in "stickers"; the remaining alloys were successfully extruded at a ratio of 4:1. Preliminary indications are that extrusion recoveries will be low. In general, bars extruded at high temperatures contained relatively deep surface ruptures, while those extruded at low temperatures contained internal cracks. (auth)

22151 (AD-281769) HIGH TEMPERATURE MATERIALS DEVELOPMENT. Progress Report No. 30, June 1962. (Raytheon Co., Waltham, Mass.). July 15, 1962. Contract NOrd-19135 (FBM). 5p. (S-477)

Flexural strength on the order of steel was found with the Zr–pyrographite alloy even for delaminated material. New techniques were developed to overcome feed line plugging and vacuum difficulties in producing high-strength zirconium alloy pyrographite. The microstructure of the carbon–carbide material is unlike either parent substance and exhibits striations rather than cones or grains. (auth)

22152 (AD-285518) HIGH TEMPERATURE MATERIALS DEVELOPMENT. Progress Report, August 1962. (Raytheon Co. Research Div., Waltham, Mass.). Sept. 15, 1962. Contract NOrd 19135(FBM). 6p. (S-467)

Test bars of zirconium Pyrocarbide containing an excess of Pyrographite were tested in flexure to 2000°C. The exceptional strength of the material increased with temperature to 2000°C where it began to deform plastically indicating that it should be ideal in thermal shock resistance. Pellets of graphite with 20% additions of ZrC, TaC, and HfC heated to 3100°C showed no signs of melting. (auth)

22153 (AD-291066) 4HT JET BLAST BURNER EVALUATION OF SELECTED GRAPHITES AND REFRACTORY MATERIALS. Technical Memorandum MT-M49. W. F. Courtis and C. Rodziewicz (Chrysler Corp. Missiles Div., Detroit). Dec. 18, 1957. 16p.

The 4HT jet blast burner facility of the Army Ballistic Missile Agency was utilized to investigate the resistance of selected graphites (treated and untreated) and refractory

materials to the ablation effects of hot, high-velocity gases. The test results were used as a preliminary evaluation of materials tentatively being considered as alternate jet vane materials. The materials that gave results comparable to those of CS-312 were selected for full-scale static firing testing. (auth)

22154 (AERE-M-1192) HIGH TEMPERATURE X-RAY DIFFRACTION STUDIES. PART 4. THE THERMAL EXPANSION OF U_4O_9. I. F. Ferguson and R. S. Street (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1963. 10p.

High-temperature x-ray-diffraction studies were made of a sample of $UO_{2.235}$ in a Unicam S 150 camera. These studies, which confirmed the results of earlier workers, extended to 1026° where a discontinuity in the variation of cube cell edge with temperature was noted. This discontinuity was believed to represent the transition to a two-phase mixture. An unexpected reaction was noted at elevated temperatures between the sample and either the Pt used as an internal temperature standard or gas adsorbed by it when they were mixed in the x ray capillary. (auth)

22155 (ARF-B6005-5) RESEARCH DESIGNED TO EVALUATE Zr–2.5Nb AND Zr–2.5Nb–0.5Cu ALLOYS FOR DELAYED FAILURE HYDRIDE SUSCEPTIBILITY. Quarterly Report No. 2, January 15, 1963–April 14, 1963. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 23, 1963. Contract AT(11-1)-578. 17p.

Activities in a program to determine the extent to which Zr–2.5Nb and Zr–2.5Nb–0.5Cu exhibit delayed failure under various conditions of H_2 content, heat treatment, ambient temperature, and specimen geometry are reported. Specimens are hydrogenated to 200 ppm or 500 ppm by means of a modified Sieverts apparatus, heat treated or cold (150°C) reduced, and then evaluated in dynamic tensile and delayed failure tests. Data on the ternary alloy show that the beta-quenched and aged condition is the most sensitive to static fatigue fracture. At room temperature, unnotched specimens containing 500 ppm H_2 showed the ordinary dynamic tensile stress-strain curve with rather good properties for a Zr alloy. However, at an applied stress of 95% of the yield stress, static fracture occurred after several hundred hours. Other data are presented which indicate that this material is generally susceptible to static fatigue; however, additional work is necessary for more confident conclusions. (auth)

22156 (ARL-63-15) A FUNDAMENTAL INVESTIGATION OF THE ALLOYING BEHAVIOR OF THE RARE EARTH AND RELATED METALS. J. F. Nachman, C. E. Lundin, and A. S. Yamamoto (Denver. Univ. Denver Research Inst.). Nov. 1962. Contract AF 33(616)-6787. 68p.

The vapor pressures of Pr, Nd, and Sm were measured with a Knudsen effusion apparatus. Also, by use of the same apparatus, thermodynamic activities of the liquid phase of the Pr–Nd system were determined. Heats of vaporization were established from the vapor pressure data for the three metals. The phase diagram for the Pr–Nd system was determined from thermal analyses, metallographic examinations, and x-ray diffraction studies. Results of the thermodynamic activity studies and measurements of solid (room-temperature) and liquid densities indicate ideal behavior in both liquid and solid solutions, within the experimental error. Ideal behavior was predicted for the Pr–Nd system, as there are essentially no differences between the component elements in considering such variables as electronic structure, crystal structure, atomic diameter, valency effect, electronegativity, and electron concentration. (auth)

22157 (ASD-TDR-62-1018) SOLUBILITY AND DIFFUSION OF GASES IN BERYLLIUM. J. P. Pemsler, R. W. Anderson, and E. J. Rapperport (Nuclear Metals, Inc., Concord, Mass.). Mar. 1962. Contract AF33(616)-7665. 25p.

Results of an experimental program to determine the solubility and diffusion rate of N, H, and O in Be are reported. The solubility of N in Be at 1000°C is estimated to be about 60 ppm, and appears to be temperature independent. The results of N diffusion experiments are considered tentative. The solubility of H in Be is believed to be very small. Measurement of the growth characteristics of H bubbles formed in Be by proton bombardment indicate a value for the diffusion coefficient of H in Be of 9×10^{-10} cm^2/sec at 850°C. Owing to limitations of chemical analysis, no new data concerning the Be–O system were obtained. (auth)

22158 (AWRE-O-13/63) THE EFFECT OF TIME AND TEMPERATURE OF HEAT TREATMENT AND STRAIN RATE ON THE TENSILE PROPERTIES AT 600°C OF BERYLLIUM–IRON ALLOYS CONTAINING 0.04–0.40 W/O IRON. F. Morrow and A. Moore (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Apr. 1963. 28p.

Studies were made on alloys based on commercially pure, vacuum-cast electrolytic flake Be containing 0.04 wt % Fe; the alloys contained 0.08, 0.15, 0.18, 0.3, and 0.4 wt % Fe and the grains were equi-axed and of 80-μ dia. The tensile properties obtained after overaging and measured using strain rates $\geq 2.7 \times 10^{-2}$/min were independent of cooling rate from, and temperature at which the overaged state was produced: only if the strain rate was $< 2.7 \times 10^{-2}$/min were the properties affected by the cooling rate. No grain growth occurred during the overaging treatment but generally grain growth occurred after solutionizing for >10 min and at temperatures ~25°C above the solvus. Such grain growth resulted in a decrease in the maximum ductility that may be subsequently obtained by overaging; increasing the grain size from ~80 to 240 μ resulted in a decrease in ductility from 40% to 10%. Optimum mechanical properties at 600°C were obtained in an alloy containing 0.15 wt % iron. Cursory work on the alloy containing 0.40 wt % iron suggested that the rate of overaging may be increased by deformation prior to aging. (P.C.H.)

22159 (BMI-X-221) PROGRESS ON USAEC/AECL COOPERATIVE PROGRAM. Quarterly Report for Period December 1962–February 1963. Stanley W. Porembka (Battelle Memorial Inst., Columbus, Ohio). Mar. 12, 1963. Contract W-7405-eng-92. 10p.

Studies are being made of the creep-rupture properties of SAP alloys. Short-term tests were completed on SAP-895 and M-257 at 700, 800, and 900°F. Rupture data were plotted as stress-versus-rupture time curves. (M.C.G.)

22160 (DRI-2094) THE KINETICS OF TRANSFORMATION OF NIOBIUM-BASE, ZIRCONIUM ALLOYS. Final Report. Charles E. Lundin and Ronald H. Cox (Denver. Univ. Denver Research Inst.). Mar. 27, 1963. Contract AT(11-1)-752. 72p.

The age-hardening characteristics of Nb-base, Zr al-

loys were investigated. Alloys were aged in the Nb solid solution plus alpha-Zr region at the isothermal temperature levels: 450, 500, 550, and 600°C. Hardness data provided the primary means of evaluating the structural effects; resistivity and tensile tests were auxiliary aids. Metallography, electron microscopy, and x-ray diffraction were used to study the various stages of precipitation. In general, all of the alloys exhibited an increase in hardness, and the hardness increase appeared earlier and was more pronounced with increasing aging temperature. The optimum hardness appeared beyond 10 hr in all cases. The 17, 18, and 21 wt % Zr alloys aged at 550°C had the largest hardness increases, and tensile data revealed an increase in ultimate strength upon aging. (auth)

22161 (DRI-2096) THE EQUILIBRIUM PHASE DIAGRAM, NIOBIUM–ALUMINUM. Final Report. Charles E. Lundin and Albert S. Yamamoto (Denver. Univ. Denver Research Inst.). Apr. 1963. Contract AT(11-1)-1092. 51p.

The binary equilibrium phase diagram of niobium-aluminum alloys was studied by metallographic, x-ray diffraction, hardness, and thermal analysis techniques. Auxiliary equilibria data were obtained by hardness and incipient-melting techniques. Metallographic studies were conducted on both as-cast and annealed-and-quenched alloys. Three intermediate phases were established; Nb_3Al, Nb_2Al, and $NbAl_3$. The Nb_3Al and Nb_2Al phases both have ranges of solid solubility. The Nb_3Al and Nb_2Al intermediate phases are formed peritectically at 1960 ± 10°C and 1870 ± 10°C, respectively, whereas the $NbAl_3$ phase forms congruently from the melt at 1605 ± 10°C. Structural and lattice parameter data for the intermediate phases were determined by x-ray diffraction. The maximum solid solubility of Al in Nb is 23.0 ± 0.5 at. % (8.0 wt %)Al at 1960 ± 10°C. A eutectic reaction occurs at 57.8 ± 0.5 at. % (28.5 wt %)Al and 1550 ± 10°C between Nb_2Al and $NbAl_3$. The Al-rich end of the diagram has a peritectic reaction at 661.4 ± 0.5°C within less than 1 wt % Nb. The maximum solid solubility of Nb in Al is less than 0.3 ± 0.1 at. % (1.0 wt %)Nb. (auth)

22162 (GEMP-186) PROBLEMS ASSOCIATED WITH HIGH-TEMPERATURE FASTENERS. J. C. Blake, H. J. Kurtz, and R. L. Sundin (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 15, 1963. Contract AT(40-1)-2847. 28p.

Stress relaxation data are given for Inconel X bolts and nuts at 700, 900, and 1100°F for periods of time up to 500 hr. Also covered in detail are the unresolved problems associated with the application of high-temperature fasteners to nuclear reactors or other critical types of mechanisms where high reliability is required. (auth)

22163 (IA-787) GRAIN GROWTH IN A URANIUM–0.45 a/o CHROMIUM ALLOY. P. Wynblatt and A. Bar-Or (Israel. Atomic Energy Commission, Rehovoth). Jan. 1963. 13p.

Grain growth of heat-treated U–0.45 at. % Cr alloy samples annealed for long periods at high temperatures in the α-range was investigated. Maximum growth (factor of 2) was found in a sample that had undergone isothermal transformation at 525°C and had subsequently been annealed for 100 hours at 625°C. The low rate of grain growth, even at high temperatures, is a point in favor for the use of the alloy as a nuclear fuel. (auth)

22164 (K-1460) HOT HARDNESS OF ELECTROLESS NICKEL COATINGS. K. T. Ziehlke (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 10, 1962. Contract W-7405-eng-26. 12p.

The hardness of heat-treated, electroless Ni coatings was measured at temperatures from 75 to 1000°F. The effects of P content from 6.8 to 10.5 wt % on both hot hardness and physical structure were determined. Temperatures to 700°F have a moderate effect on the coatings, which have useful hardnesses if that temperature is not exceeded. The interrelationship of hardness and temperature from 75 to 700°F is shown in a nomogram, from which the hardness at any temperature can be determined if the hardness at any other temperature is known. (auth)

22165 (LA-2880) SELF-DIFFUSION IN SINGLE-CRYSTAL TUNGSTEN AND DIFFUSION OF RHENIUM TRACER IN SINGLE-CRYSTAL TUNGSTEN. Robert L. Andelin (Los Alamos Scientific Lab., N. Mex.). Mar. 1963. Contract W-7405-eng-36. 154p.

Self-diffusion in single-crystal W, and diffusion of Re tracer in single-crystal W were measured at 2660 to 3230°C by the direct-sectioning technique. The initial radioactive layer of W and Re tracers was produced on the diffusion samples by bombardment with 9.0-Mev deuterons. It was shown that the initial radioactive layer satisfactorily approximated the boundary-condition requirements of the one-dimensional diffusion equation. The tracers observed in determining the diffusion coefficients were W^{185}, Re^{183}, and Re^{184}. In the process of determining an optimum deuteron energy for activation of the diffusion samples, total cross sections as a function of deuteron energy were measured for the reactions $W^{184}(d,p)W^{185}$, $W^{186}(d,p)W^{187}$, and $W^{184}(d,2n)Re^{184}$ by the stacked-foil technique. Cross-section values for the reactions leading to the production of both W^{185} and W^{187} increased from about 3 mb at 6 Mev to a fairly broad maximum of 300 mb between 11 and 13 Mev. Cross sections for production of 34-day Re^{184} range from about 3 to 380 mb for deuterons with energies ranging from 7 to 14 Mev. Deuteron energies employed (14-Mev maximum) were not high enough to indicate the position of the maximum for the $W^{184}(d,2n)Re^{184}$ excitation function. The decay of W^{185} was observed over a period of about 9 half lives, and a new half-life value of 75.14 ± 0.63 days, with the uncertainty expressed to 3 σ, was obtained. The half-life value obtained for W^{187} was 23.72 ± 0.06 hours. (auth)

22166 (NCSC-2663-11) URANIUM INTERSTITIAL PHASES. Quarterly Progress Report, March 1963. Robert F. Stoops and John V. Hamme (North Carolina State Coll., Raleigh). Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2663. 17p. (EURAEC-654)

A comprehensive review of all past project research was completed. Results of the review indicated that slight changes should be made in the U–C–O phase diagram previously reported, and these were made after a few critical experiments were completed. The phase diagram now shows that the total number of C and O atoms can exceed the number of U atoms in the U(C,O) phase. This is in agreement with lattice-parameter determinations made in this investigation. The CO equilibrium partial pressure for the $U-UO_2-U(C_{.75}O_{.25})$ ternary phase area was determined to vary from 9 microns of Hg at 1705°C to 183 microns at 1855°C. Cursory experiments indicate that $U(C_{.75}O_{.25})$ is considerably more stable in contact with water than UC. (auth)

22167 (UCRL-10198) DIRECT OBSERVATIONS OF PRECIPITATION IN THIN FOILS OF Al–20% Ag ALLOY. J. A. Hren and G. Thomas (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1962. Contract W-7405-eng-48. 43p.

A high temperature stage was used to study precipitation and dissolution in thin foils of Al–20% Ag alloy directly in the electron microscope. The results show that the aging characteristics are similar to those observed for bulk materials, and in addition, direct evidence is presented for clustering at the solid solution temperature. The limit of solubility of G.P. zones is ~350°C. The heterogeneous precipitation, growth, and dissolution of γ' were studied in detail. Growth of γ' parallel to the basal planes occurs by continuous motion of interfacial partial dislocations. Growth stops at intersecting particles due to formation of sessile a/6 (110) interfacial dislocations. Growth normal to the habit plane occurs by the spontaneous nucleation of partial dislocations on alternate (111) planes and the thickening rate is $\sim 10^{-3}$ times the lengthening rate. The precipitates dissolve in layers and the final product is a whole a/2 (110) dislocation. The nucleation-growth-dissolution processes are thus completely reversible. Kinetic data obtained from the dissolution rates of γ' particles enable the diffusion coefficient to be determined and the activation energy was found to be 37.5(±4) kcal mol^{-1}. The velocity of the interfacial dislocations is thus dependent solely on the rate of diffusion of silver atoms. (auth)

22168 (WADD-TD-60-143(Pt.IV)) RESEARCH STUDY TO DETERMINE THE PHASE EQUILIBRIUM RELATIONS OF SELECTED METAL CARBIDES AT HIGH TEMPERATURES. R. V. Sara, C. E. Lowell, and R. T. Dolloff (National Carbon Co. Research Lab., Parma, Ohio). Feb. 28, 1963. Contract AF33(657)-8025. 41p.

Information is summarized which is the result of investigations of phase equilibria in the binary systems C–Zr, Ta–C, and B–C. A completed phase diagram, which encompasses experimental results and considerations heretofore unreported in the literature, is presented for the Zr–C system. A tentative phase diagram for the Ta–C system is included, which, in general, resembles the version released by Ellinger in 1943. Preliminary results for the B–C system, depicting maximum solubility in the graphite lattice below the eutectic temperature of approximately 2390°C, are also included. (auth)

22169 (EURAEC-513) THE DIFFUSION OF INERT GASES IN SOLID BODIES. Quarterly Report No. 1, Quarterly Report No. 10, October 1–December 31, 1962. (Hahn-Meitner-Institut für Kernforschung, Berlin). Work Performed under United States–Euratom Joint Research and Development Program. Contract 094-62-9RDD. 8p. A translation.

The diffusion of argon in KBr and KCl and xenon diffusion in ThO_2, UC, and UO_2 received further investigation. Alterations were made to the apparatus to permit study of the initial processes in KCl diffusion experiments. Tests on normal and NH_3NO_3-doped tablets of 8 tons pressure tension revealed that the NH_4NO_3-compounded tablets yield a greater percentage of inert gas. Inert gas yield obtained from a natural UO_2 crystal of Bröggerit mineral was much greater than that from artificial crystals. Longer irradiation apparently increased the xenon yield from UC. (D.C.W.)

22170 (EURAEC-526) DIFFUSION OF RARE GASES IN SOLIDS. Final Report, September 1961 to August 1962. (Hahn-Meitner-Institut fur Kernforschung, Berlin). Dec. 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 064-61-8-RDD. 44p. A translation.

The evaluation of post-activation diffusion (PAD) measurements, the experimental methods used for the diffusion measurements, and the assay of the radioactive rare gases are described. Experimental results of PAD measurements on the systems CaF_2–Ar, KF–Ar, UO_2–Xe, and ThO_2–Xe are given in the form of release curves and activation energies. Deviations from the ideal case of pure volume diffusion were observed with polycrystalline and sintered material and are discussed in a survey of parameters affecting the rare gas release from solids. (auth)

22171 (JPRS-18920) POWDER METALLURGY OF THORIUM. A. N. Zelikman. Translated from p.218-21 of "Toriya i Urana," Moscow, 1961. 3p. (OTS-63-21690).

A review is presented on the powder metallurgy of compact thorium. The compositions and mechanical properties of Th produced by various methods are compared, and the properties of compact Th produced by powder metallurgy from electrolytic and calcium-thermal reduction are tabulated. (P.C.H.)

22172 THE CRYSTAL STRUCTURES OF Y_3Al_2 AND YAl. Tore Dagerhamn (Stockholm Univ.). Acta Chem. Scand., 17: 267(1963). (In English)

The lines of the Y_3Al_2 x-ray powder pattern could be indexed with a tetragonal unit cell with a = 8.239 ± 0.003 A, c = 7.648 ± 0.004 A, and c/a = 0.928. A unit cell of 4 formula units of Y_3Al_2 gives a calculated density of 4.10, in agreement with the observed density of 4.06. The calculated line intensities are in good agreement with the observed intensities. The phase YAl has an orthorhombic unit cell with a = 3.884 ± 0.002 A, b = 11.522 ± 0.004 A, and c = 4.385 ± 0.002 A. With 4 formula units of YCl in the cell, the calculated density is 3.92 as compared with an observed value of 3.98. The atomic arrangement of YAl is given. (D.L.C.)

22173 THERMAL SHOCK RESISTANCE OF CERAMIC MATERIALS. G. A. Rubin (Deutsche Steinzeug- und Kunststoffwarenfabrik, Mannheim-Friedrichsfeld, Ger.). Ber. Deut. Keram. Ges., 40: 13-15(Jan. 1963). (In German)

The temperature dependence of the thermal shock resistance of sintered alumina and beryllia was studied by use of literature values, and new measurements of the tensile strength, thermal conductivity, lin. coefficient of expansion, and elastic modulus of these sintered compounds were made. In case of a moderate heat exchange rate on cooling, BeO proves to be far superior to Al_2O_3 because of its high thermal conductivity. In case of a high heat exchange rate, Al_2O_3 is more resistant to thermal shock than BeO due to its higher strength. (auth)

22174 AN ETCHANT FOR SINTERED ALUMINA. A. Bassi and G. Camona (CISE, Milan). Energia Nucl. (Milan), 10: 215-16(Apr. 1963). (In English)

A metallographic method for the observation of the morphology of sintered alumina is described. The best polishing results were obtained using heavy, narrow-mesh cloth for polishing with paste of 14 and 16μ, while for successive operations, particularly light, wide-mesh cloth was used. Fluoboric acid mixed with a small quantity of potassium bisulfate was used as an etchant. The solution is used at its boiling point for 6 min. (M.C.G.)

22175 THE MAGNETORESISTANCE OF LITHIUM. D. Gugan and B. K. Jones (Wills Physics Lab., Bristol, Eng.). Helv. Phys. Acta, 36: 7-11(1963). (In English)

Measurements are reported on the magnetoresistance of the three phases of lithium. The reduced magnetoresistances for a given low field are in the ratios 4.5 : 1.6 : 1.0 for the b.c.c., f.c.c., and h.c.p. phases. (auth)

22176 THE PROPERTIES OF RHENIUM, RHENIUM–TUNGSTEN AND RHENIUM–MOLYBDENUM ALLOYS. E. M. Savitskii, M. A. Tylkina, L. L. Zhdanova, L. A. Zubkova, V. N. Starkov, A. G. Fokin, L. S. Petrova, and T. I. Arkusha. Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met., 9: 194-203(1962).

The mechanical properties and microstructure of Re–W and Re–Mo alloys were investigated at room temperature and at 2600 to 3400°C. Methods of casting and of plastic deformation of W–Re, Mo–Re, and W–Mo–Re alloys were developed. It was shown that when W and Mo are alloyed with Re there is an increase in plasticity, in machinability, in weldability, and in strength, and the temperature of recrystallization increases by 400 to 500°C. (P.C.H.)

22177 EFFECTS OF ZIRCONIUM, NIOBIUM, AND MOLYBDENUM ON IRON SELF-DIFFUSION. V. V. Sanadze, T. A. Tsivtsivadze, and K. G. T. Tatrishvili (Georgian Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 6, 38-43(1962). (In Russian)

Radioactive Fe^{59} was used in an investigation of the influence of Zr, Nb, and Mo admixtures on self-diffusion in iron. Volume and intercrystalline diffusion were analyzed, and the course of activation energy in both processes was determined. (tr-auth)

22178 THE CREEP OF NIOBIUM. G. Brinson and B. B. Argent (Univ. of Sheffield, Eng.). J. Inst. Metals, 91: 293-8(May 1963).

The creep of niobium in compression between 800 and 1200°C is described. The niobium was purified by zone melting, and subsequent contamination was prevented by testing in a vacuum of $<10^{-6}$ mm Hg. Above 1000°C the creep behavior is complicated by changes in grain size, probably due to recrystallization. The creep strength of the material examined is much lower than that found by other investigators, and the low oxygen content is probably a major reason for the low strength. (auth)

22179 PERIODIC ANTIPHASES WITH NON-INTEGRAL PERIODS. Abraham Hauptman, Romain Kleinberger, Hiroshi Ikuzumi, Pierre Perio, and Max Tournarie (CEN, Saclay, France). J. Phys. Soc. Japan, 17: 285-8(Feb. 1962). (CEA-1955). (In French)

A theory based on statistical considerations, leading to a simple classification of the diffraction diagrams of antiphase with non-integral periods, is proposed. In comparing it with previous studies, an attempt is made to clarify apparent differences due to terminology. It appears that several different models can have the same qualitative diffraction diagram, and that only quantitative measurements, difficult to make and to interpret, can distinguish between them. (auth)

22180 PROPERTIES OF POLYETHYLENE-ACRYLIC ACID GRAFT COPOLYMERS. James K. Rieke and Gerald M. Hart (Dow Chemical Co., Midland, Mich.). J. Polymer Sci., Pt. C, 1: 117-33(1963).

A graft copolymer of high-density polyethylene and acrylic acid was prepared by pre-irradiation activation of the polyethylene. The properties of an 8% acrylic acid copolymer were compared to the parent polyethylene and polyacrylic acid over a range of temperatures. Most properties measured exhibit the type of behavior expected for this type of structure. In general, the property trends observed in high-density polyethylene are retained in the graft copolymer. The greatest physical property change is observed as an increase in tensile modulus of about 15–25,000 psi when measured at room temperature. The adhesiveness of the graft copolymer is greatly improved over that of polyethylene, but very little change is noted in the moisture sensitivity or crystallinity. The data also suggest that the introduction of the acid group introduces sites for hydrogen bonding or for further chemical reactions. (auth)

22181 A STUDY OF BRITTLE FRACTURE IN CRYOGENIC ALLOYS. Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson, and William E. Witzell (General Dynamics Corp., San Diego, Calif.). Metal Progr., 83: No. 5, 103-6(May 1963).

Normally ductile materials subjected to complex high stresses, while exposed to subzero temperatures, may fracture in a brittle manner. Nuclear irradiation at cryogenic temperatures decreases tensile strength and markedly lowers the amount of plastic strain that promising structural alloys can sustain between yield and fracture. (auth)

22182 THE HARDENING BEHAVIOR OF AN Al–Mg–Si ALLOY. H. Borchers and M. Kainz (Technische Hochschule, Munich). Metall, 17: 192-6(Mar. 1963). (In German)

The hardening behavior and the effect of solution treatment and quenching conditions were studied for an Al alloy with 0.6% Mg, 0.8% Si, 0.39% Mn, 0.42% Fe, 0.12% Zn, and 0.04% Cu. An Al–Fe–Mn–Si phase was detected by etching methods, and the phase boundaries were determined. From the temperature-time relation of the hardness, the activation energy can be determined. The resistance isotherms, measured at temperatures from –80 to 350°C, permitted, in conjunction with the hardness measurements, a definite separation of the cold hardening from the thermal hardening to be made. The effect of the solution tempering conditions on the hardening was investigated extensively. Whereas the quench hardening decreases with increasing solution treatment temperature and time, the hardness maximum at 160°C increases with increasing quenching temperature. This was traced back to the effect of a higher vacancy concentration. With longer solution treatment times, a decrease in the maximum and quench hardening was detected; it was related to an increasing deformation of the Al–Fe–Mn–Si phase. From the different hardening patterns in various quenching media, it could be established that the vacancies were affected not only by the precipitation velocity but also by the distribution of the precipitation grains. Precipitation on grain and subgrain boundaries, both discontinuous and homogeneous, could be established by microscopic investigations at 160 to 400°C. (tr-auth)

22183 STUDY ON THE IMPROVEMENT OF METALLIC URANIUM FUEL. I. THE EFFECTS OF ADDITIVE ELEMENTS, HEAT TREATMENTS AND HOT-ROLLING PROCESS TO THE GRAIN SIZE OF METALLIC URANIUM. Kazuo Maruya (Mitsubishi Atomic Power Industries, Inc., Omiya, Saitama Prefecture, Japan) and Jōtaro Kimura. Nippon Genshiryoku Gakkaishi, 5: 194-204(Mar. 1963). (In Japanese)

It is very important to find out the effective method to prevent the anisotropic growth of metallic uranium due to thermal cycling and neutron irradiation in order to achieve high burn-up of metallic uranium fuel. The grain refinement degree of the binary and ternary alloys containing minor additive of Al, Cr, Fe, Mo, Nb, Si, Ti, W, and Zr was studied after the appropriate heat treatments and hot rollings. Major experimental results are summarized as follows: (1) There were remarkable grain refinement of uranium by the addition of Cr, Nb, Mo, and Zr with an adequate heat treatment. These phenomena were considered mainly due to the transformation of nucleation and

growth type. In addition, the change of volume on phase transformation, the delay of transformation rate on cooling or quenching, the remaining stress by precipitation of another phase on tempering, and the precipitation of non-metallic inclusions might have some roles on the grain refinement of uranium. (2) The grain refinement was performed appreciably by the addition of 0.2% Cr, 0.3 to 0.6% Nb, 0.5 to 1.0% Mo, and 1.0 to 2.0% Zr, respectively, with the gamma heat treatment. The concentration variation in the range mentioned was not a notable factor in the refinement. (3) The ternary alloys with two additives showed good grain refinement effect on uranium. (4) Hot-rolling process showed no effect on the grain refinement. (5) Ternary alloys of U–Nb (0.3 to 0.6%)–Mo(0.3 to 2.0%) and U–Nb(0.3 to 1.5%)–Zr(>1%) showed the fine grain textures and good workability in hot rolling. These alloys indicate the direction of improvement of metallic uranium. (auth)

22184 PHASE CHANGE AND HEAT TREATMENT OF U–Fe ALLOYS. [PART] I. Kō Soeno (Hitachi Ltd., Japan). Nippon Genshiryoku Gakkaishi, 5: 204-10(Mar. 1963). (In Japanese)

A series of uranium alloys varying in iron content from 0.5 to 1.0 at. % was quenched into water from various β- and γ-phase temperatures. Dilatation curves were determined by heating quenched specimens to obtain information about the retention of β and γ uranium. According to the results obtained, γ-to-β transformation is not interrupted by quenching, but β-uranium is retained in metastable state at room temperature. In the case of heating the quenched specimens, retained β-uranium transforms to α-uranium, but the martensitic transformation becomes more sluggish with increasing iron content. In γ-quenched U – 1.0 at. % Fe alloy, most of the retained β-uranium transforms in α nucleation and growth mechanism, whose activation energy is 43.0 kcal/g-atom. (auth)

22185 THE PREPARATION OF THORIUM OXIDE MICROSPHERES. III. THE PROPERTIES OF SPHERICAL THORIUM OXIDE AND THE INFLUENCES OF SMALL AMOUNT OF ADDITIVES. Yasaburo Yamazaki, Kenzo Hoshida, and Matsuo Komori (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 225-30(Mar. 1963). (In Japanese)

Spherical thorium hydroxide prepared by spraying thorium hydroxide sol into isopropyl alcohol was filtered, washed, dried, and calcined to form thorium oxide microspheres. Calcination time (5 to 19 hr) did not show a definite tendency on the particle density, which reaches as high as 10 g/cm^3. Mean particle diameter was found to be inversely proportional to injection velocity of the hydroxide sol. As an index of fragility of the particles, a water suspension of the particles was agitated violently in a Waring Blender for 1 hr, and particle size distribution before and after the treatment was measured. Considerable disintegration was found for larger particles (>20 μ). Thorium oxide microspheres which contain a small amount of Al or Si or U (mixed thorium oxide) can be made from the sol containing additive by the same spray method as for pure thorium oxide. Within the calcination temperature of 600 to 1600°C, the density of the mixed thorium oxide increases with temperature up to 1300°C, and reaches as high as 9.92. At 1600°C, however, the particles, particularly the Al-mixed ones, sintered. Tests with the Waring Blender did not show a significant effect. Again the smaller particles were almost unchanged in size. (auth)

22186 LONG-RANGE ANTIFERROMAGNETISM IN DISORDERED Fe–Ni–Mn ALLOYS. J. S. Kouvel and J. S. Kasper (General Electric Co., Schenectady, N. Y.). Phys. Chem. Solids, 24: 529-36(Apr. 1963). (In English)

Neutron diffraction measurements at 77 and 298°K reveal long-range antiferromagnetic ordering in the atomically disordered face-centered cubic alloys with more than about 50 at. per cent Fe in the ternary series $(Ni,Fe)_3Mn$. Consistent with these results, the Néel temperatures of these alloys, deduced from the temperature dependence of their electrical resistivities, rise from 210 to 425°K as the iron concentration increases from 50 to 75 at. per cent. An antiferromagnetic structure that conforms to the neutron diffraction polycrystal data is the collinear, tetragonal configuration previously reported for the Mn-rich Mn–Cu alloys. However, quite unlike Mn–Cu, the Fe–Ni–Mn alloys give no detectable x-ray diffraction evidence for a tetragonal (or any other) distortion of their cubic atomic arrangement. Hence, an alternative structure proposed for these alloys is one that is cubic though not collinear, the moments on four equivalent sublattices being oriented along different (111) directions such that their vector sum is zero. Both these magnetic structures are then shown to be special cases of a general set of non-collinear, tetragonal configurations which produce the same neutron diffraction pattern for a given magnitude of the average atomic moment $\bar{\mu}$. For the $(Ni,Fe)_3Mn$ series it is found that $\bar{\mu}$ increases from 1.1 to 1.7 μ_B with increasing iron concentration from 50 to 75 at. per cent, which is shown to be at least in part due to an improved degree of long-range magnetic order. The results of the present work are compared and related to the unusual ferromagnetic–antiferromagnetic behavior of the more Ni-rich alloys in this ternary series and to the low-temperature antiferromagnetic structure recently reported for γ-iron. (auth)

22187 ABSENCE OF ANTIFERROMAGNETISM IN PALLADIUM. S. C. Abrahams (Bell Telephone Labs., Murray Hill, N. J.). Phys. Chem. Solids, 24: 589-90(Apr. 1963). (In English)

Neutron diffraction experiments were carried out on polycrystalline and single-crystal palladium in an attempt to observe magnetic neutron scattering due to an antiferromagnetic lattice. No such evidence for antiferromagnetism was found, and it is concluded that the largest single spin-axis moment per palladium atom is less than 0.03 Bohr magnetons. (D.L.C.)

22188 SPECIFIC HEAT OF VARIOUS GRAPHITES BETWEEN 0.4 AND 2.0°K. B. J. C. van der Hoeven, Jr. and P. H. Keesom (Purdue Univ., Lafayette, Ind.). Phys. Rev., 130: 1318-21(May 15, 1963).

Below 1.2°K the specific heat of natural Madagascar graphite is: $C = 13.8\ T + 27.7\ T^3\ \mu J/mole\ deg$. The coefficient of the linear term agrees well with theoretical calculations of the electronic specific heat of a pure single crystal of graphite. The T^3 term yields a Debye parameter, Θ_0, of 413°K. For pile graphite, lampblack, and pyrographite it is found that the specific heat is directly dependent on the degree of stacking faults. This is in agreement with the theory which proposes that stacking faults will decrease the value of c_{44}, the elastic constant of shear between neighboring layers, which leads to additional modes at low temperatures and thus adds to the specific heat. (auth)

22189 ELASTIC CONSTANTS OF TANTALUM, TUNGSTEN, AND MOLYBDENUM. F. H. Featherston and J. R. Neighbours (Naval Postgraduate School, Monterey, Calif.). Phys. Rev., 130: 1324-33(May 15, 1963).

The elastic constants of tantalum, tungsten, and molybdenum were measured in the temperature range between 4.2

and 300°K. The directly measured quantities C_L and $\frac{1}{2}(C_{11}-C_{12})$ for molybdenum and the computed bulk moduli of all three elements show an anomalous temperature dependence. These data along with published results for other metals generally show a difference in temperature dependence of the bulk modulus between 3d and 4d–5d metals. Overlap contributions to the elastic constants are found to favor an antiferromagnetic ordering. The Debye characteristic temperatures calculated from elastic constants are found to be in substantial agreement with results obtained from calorimetry. (auth)

22190 CALCULATED VIBRATIONAL SPECTRA AND SPECIFIC HEATS OF LITHIUM AND VANADIUM. John B. Hendricks (Texas Instruments Inc., Dallas and Southern Methodist Univ., Dallas), Henry N. Riser, and Clifton Bob Clark. Phys. Rev., 130: 1377-80(May 15, 1963).

Vibrational spectra and specific heats were calculated for lithium and vanadium, from measured elastic constants, on the basis of three different models. Two of the models are of the Born-von Kármán type. One of these considers only central forces between nearest and next-nearest neighbors; the other includes noncentral forces between nearest neighbors and central forces between next-nearest neighbors. The third model is due to de Launay. The calculated quantities from all models are compared with the available empirical values and values calculated by others. It is concluded that none of the models is a satisfactory representation of either metal. (auth)

22191 LOW-TEMPERATURE SPECIFIC HEATS OF TITANIUM, ZIRCONIUM, AND HAFNIUM. G. D. Kneip, Jr., J. O. Betterton, Jr., and J. O. Scarbrough (Oak Ridge National Lab., Tenn.). Phys. Rev., 130: 1687-92(June 1, 1963).

The specific heats of titanium, zirconium, and hafnium were found to obey the relation $c = \gamma T + \beta T^3$ from 1.1 to 4.5°K within the experimental error. As in other transition metals, the electronic term is large and for the Group IV-A metals decreases with increasing atomic number indicating a progressively larger degree of electronic interaction in the sequence titanium, zirconium, and hafnium. The Debye temperatures decrease with increasing atomic mass as would be expected from the central-force model; however, the ratio of the Debye temperatures indicate that the average atomic force constant for hafnium is some 50% larger than for titanium and zirconium in agreement with the unusually small atomic volume of hafnium. (auth)

22192 INFLUENCE OF ELECTRON INTERACTIONS ON METALLIC PROPERTIES. II. ELECTRON SPIN PARAMAGNETISM. S. D. Silverstein (Univ. of Illinois, Urbana and Univ. of California, Berkeley). Phys. Rev., 130: 1703-10(June 1, 1963).

The static-electron-paramagnetic spin susceptibility was calculated by a variational calculation about a polarized ground state, the polarization parameter being determined as the extremum condition on the ground-state energy. The basic techniques used are those of many-body perturbation theory in a fashion analogous to that used by Brueckner and Sawada, with the addition of a momentum transfer interpolation procedure designed to obtain relevant information in the region of metallic densities. General curves are given that should be appropriate to all free-electron-like metals in both the solid and liquid state. The effects of band structure in our application to the solid alkali metals are taken into account by the introduction of the Fermi level band masses in the kinetic energy term. The results obtained by this procedure are in agreement with experiment. (auth)

22193 NEUTRON DIFFRACTION STUDY OF SHORT-RANGE ORDER IN β-CuZn. C. B. Walker (Univ. of Chicago) and D. T. Keating. Phys. Rev., 130: 1726-34 (June 1, 1963). (BNL-6675)

Neutron diffuse scattering measurements were made on an isotopically enriched single crystal of β CuZn at a series of temperatures above T_c. The observed short-range order scattering exhibited the general characteristics of critical scattering, quite unlike the diffuse scattering reported for any other ordering alloy, and confirmed that the order-disorder transformation in this alloy is a phase transformation of second (or higher) order. No quantitative evaluation of the short-range order parameters from the measured scattering was possible. A comparison of the measured scattering with calculations based on the theories of Zernike, Cowley, and Elliott and Marshall showed rather good agreement, suggesting that these simple theories give a reasonable approximation to the actual short-range order correlations above T_c. From a consideration of the discrepancies between these theories and the experimental data, it appears that at temperatures above T_c the Ising model forms a surprisingly good model for this alloy. (auth)

22194 TEMPERATURE DEPENDENCE OF LATTICE PARAMETERS FOR Gd, Dy, AND Ho. F. J. Darnell (E. I. du Pont de Nemours and Co., Wilmington, Del.). Phys. Rev., 130: 1825-8(June 1, 1963).

The lattice parameters of single-crystal Gd, Dy, and Ho were measured over their temperature ranges of magnetic ordering. The c axis and volume of all three hexagonal close-packed structures were found to increase with decreasing temperature below their respective Néel or Curie points. The temperature dependence of the c axes is in reasonable agreement with the exchange magnetostriction theory of Kittel. Discontinuities in the c axes were found for Dy and Ho, and a structure change to orthorhombic was found in Dy, at the antiferromagnetic-ferromagnetic transitions. This structure change is believed to account for the extraordinarily large values of magnetostriction reported for Dy. (auth)

22195 STUDY OF THE SYSTEM VANADIUM–MOLYBDENUM–CARBON. STABILIZATION OF CUBIC MOLYBDENUM CARBIDES. Erwin Rudy, Elizabeth Rudy, and F. Benesovsky (Metallwerk Plansee AG, Reutte/Tyrol, Austria). Planseeber. Pulvermet., 10: 42-64(Apr. 1962). (In German)

With hot-pressed, vacuum-sintered, and arc-melted specimens the system V–Mo–C was investigated by means of x-ray- and micrographical methods and sections at 1550 and 1800° resp are given. Vanadium and molybdenum as well as V_2C and Mo_2C form a continuous series of solid solutions, whereas the cubic (B1) solid solution extends to about 70 mole % Mo_3C_2 (a = 4.25 Å) at 1800°. Mo_3C_2 takes about 15 mole % VC_{1-x} into solution ($a_{subcell}$ = 4.244 Å; a = 3.004 Å; c = 14.57 Å). The results from investigations on arc-melted specimens together with thermodynamical considerations suggest a transformation of the hexagonal form of Mo_3C_2 to a cubic B1-form at high temperatures, followed by complete miscibility of VC_{1-x} with Mo_3C_2. Additions of small amounts of uranium and thorium result in a stabilization of a B1-type Mo_3C_2 (α) down to at least 1400°, whereas in the case of boron additions the B1-phase can be retained only by quenching the melt and decomposes on subsequent annealing. The pure binary cubic modification (α-Mo_3C_2) could be prepared, used a rapid cooling technique. The lattice parameter found was invariably a = 4.2810 ± 2 Å, its composition, as determined by analysis,

lies within the range from 40.0 to 40.8 at. % C. The two-phase equilibria (V, Mo)–(V, Mo)$_2$C and (V, Mo)$_2$C–(V, Mo)C$_{1-x}$ are thermodynamically analyzed. The phase Mo$_3$C$_2$ and the phase relationships in ternary systems Me$_1$-Me$_2$-C are discussed. (auth)

22196 THE TERNARY SYSTEMS (TITANIUM, ZIRCONIUM, HAFNIUM)–ALUMINUM–SILICON. O. Schob, H. Nowotny, and F. Benesovsky (Universität, Vienna and Metallwerk Plansee AG., Reutte/Tyrol, Austria). Planseeber. Pluvermet., 10: 65-71(Apr. 1962). (In German)

The ternary system Ti–Al–Si, Zr–Al–Si, and Hf–Al–Si are investigated on a section corresponding to a homogenization temperature of 1200°C. A substantial part of the existing equilibria is determined. A new silicide is observed at 45 atomic percent Si in the binary systems Ti–Si and Hf–Si, which is isotypic with the U$_1$-phase of Zr–Si. This so far not closely defined crystal type is open for determination. (auth)

22197 METALOGRAPHIC OBSERVATION ON THE PLASTIC STATE OF URANIUM OXIDE IN PRESSING. Charlotte Bueckle. Planseeber. Pluvermet., 10: 88-92 (Apr. 1962). (In German)

A metallographic study was made of the influx zones of a Vickers imprint in sintered uranium oxide after removal of a thin surface layer by polishing. The microscopic observations were made with bright field, dark field, phase contrast, polarized light, and interference. The observed plastic-brittle behavior of uranium oxide is discussed, and it is concluded that uranium oxide is an especially good example of a typical coexisting brittle and plastic state. (D.L.C.)

22198 CONTRIBUTION TO THE STUDY OF CRYSTALLINE TEXTURE AND MECHANICAL PROPERTIES OF TRANSFORMED BERYLLIUM. Claude Gasc. Publ. Sci. Tech. Min. Air (France), No. 386: 1-86(1962). (In French)

The utilization of Be by the aeronautic and nuclear industries has been limited up to the present by its very low ductility at room temperature. However, the fritted metal with oriented texture has good monodirectional ductility and, in the best cases, an acceptable bidirectional ductility. The preferred orientation of a large number of sheets, prepared under different conditions, was determined in order to define the effect of different parameters of the forming process on the final texture. In particular, it could be shown that cross rolling done directly on the fritted and non-spun metal led directly to a texture called "planotrope" that gave the best bidirectional ductility. Analysis of stresses applied during forming and of texture evolution has defined the deformation modes occurring during high-temperature working. The importance of prismatic slips, especially associated double slips, was shown, but the problem of the existence of pyramidal slips was not solved. The study of the mechanical properties of sheets whose texture was determined confirmed the effect of the texture on the metal ductility by defining the fashion in which the different slip systems operate. The mechanical tests have shown the importance of the grain size and its homogeneity. These are difficult to control because the restoration and recrystallization phenomena of Be are poorly known. The study of the stress-deformation curves showed the existence of precipitation phenomena which play an important role in the fragility of this metal. (tr-auth)

22199 FERROELECTRIC PROPERTIES OF $SrNb_2O_6$–0.5 $YbFeO_3$. E. V. Sinyakov and E. F. Dudnik (Dnepropetrovsk State Univ., USSR). Soviet Phys.-Solid State (English Transl.), 4: 2178(Apr. 1963).

The system $SrNb_2O_6$–0.5 $YbFeO_3$, exhibiting both ferroelectric and ferrimagnetic properties, was synthesized. The temperature dependence and electric field strength dependence of the specific inductive capacity were measured. (C.E.S.)

22200 MOBILITY OF Ag^{110} IN MAGNESIUM. P. P. Kuz'menko and L. F. Ostrovskii (Kiev State Univ.). Soviet Phys.-Solid State (English Transl.), 4: 2188-9(Apr. 1963).

The mobility of the radioactive isotope Ag^{110} in magnesium when a d-c current is passed through the latter was investigated. The scattering cross section of the activated silver ions in magnesium and the effective charge of the activated silver ions were determined. The scattering cross section was found to be 6.7×10^{-16} cm^2, which is close to the cross section of silver atoms. The high value of the effective charge $g_{Ag} = 1.5$ indicates that the electronic structure of Ag in magnesium is quite different from that of activated Ag in silver. (C.E.S.)

22201 L_{III} AND L_{II} ABSORPTION EDGES OF NIOBIUM. M. I. Korsunskii, Ya. E. Genkin, and L. I. Lukashenko (Kharkov Polytechnical Inst.). Soviet Phys.-Solid State (English Transl.), 4: 2190(Apr. 1963).

The L absorption spectra of metallic niobium were obtained using a long-wavelength x-ray spectrograph with Johann focusing. The wavelengths of the L_{III} and L_{II} absorption edges of metallic niobium were found to be 5223.6 ± 0.4 XU and 5022.8 ± 0.5 XU, respectively. Within the limits of experimental error the short-wavelength limits of the L_{III} and L_{II} emission spectra are the same as the long-wavelength limits of the L_{III} and L_{II} absorption edges of metallic niobium. (C.E.S.)

22202 VISCOSITY OF BF_3. G. M. Panchenkov, A. V. Makarov, V. Ya. D'yachenko, and V. D. Moiseev. Vestn. Mosk. Univ., Ser. II, Khim., No. 5, 11-13(Sept.-Oct. 1962). (In Russian)

The viscosity of BF_3 was determined by the capillary method at 20 to 700°C. The following relationship was found: $\eta = (15.9 \pm 0.4) \cdot 10^{-7}\ T^{0.821 \pm 0.004}$. (R.V.J.)

22203 COMPARISONS BETWEEN DROP WEIGHT AND CRACK ARREST TESTS FOR THE ESTIMATION OF THE BRITTLE FRACTURE TRANSITION TEMPERATURE OF STEEL. G. D. Fearnehough and H. G. Vaughan (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Welding J. (N. Y.), 42: 202s-4s(May 1963).

A comparison between nil ductility temperature (NDT) and crack arrest data from many tests on thick low-carbon pressure vessel steels shows that the (NDT + 60°F) value is similar to, but somewhat more optimistic than, the Robertson isothermal crack arrest criterion. The NDT value shows slightly worse correlation with the isothermal temperature (95% confidence estimate ±25°C) than does the Charpy 25% fibrosity temperature (+20°C). For the steels examined, NDT showed reasonable correlation with the Charpy 25% criterion but poorer correlation with the 35 ft-lb temperature. (auth)

22204 THE VARIATION OF X-RAY INTERFERENCE, HYSTERESIS, AND SURFACE IMAGE FOR SINGLE AND CYCLIC STRESS FOR BRASS, NICKEL, AND STEEL. II. CYCLE HARDENING OF PURE NICKEL. Randolf J. Hartmann and Eckard Macherauch (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 54: 197-206 (Apr. 1963). (In German)

The bending fatigue behavior of pure nickel was investigated by measuring the x-ray interference profiles, load and strain amplitude, and the surface image as a function of the number of load changes N. Special attention was

paid to the period of initial hardening. Work hardening during fatigue occurs in two steps. Stage I extends from $N = 1$ to $N = 10^2$ and is connected with the appearance of T-bands. The reasons for broadening the x-ray interferences are both the coherency length and microstrains. Stage II comprehends $10^2 < N < 10^4$ and is characterized by a strong decrease of the average coherency length and a small increase of inhomogeneous microstrains. F-bands which are typical for fatigue hardening occur at the end of stage II. Work hardening in stage I increases up to the maximum amplitude of ±30°. Work hardening in stage II increases only up to an amplitude of ±7.5° and decreases again at higher amplitudes. Pronounced F-bands occur at the critical amplitude of maximum work hardening. Dislocation pile ups on primary F-bands influence crack formation. All the observed effects can be explained by the formation of vacancy clusters in stage II. Work hardening is then determined mainly by intersecting processes. Typical for stage I are large amplitudes, and work hardening is then governed by the elastic interaction of dislocations. (auth)

22205 ON THE THERMODYNAMICS OF PHASE TRANSFORMATIONS IN TERNARY SYSTEMS. [PART] II. Erwin Rudy. Z. Metallk., 54: 213-23(Apr. 1963). (In German)

The equilibrium conditions for binary and ternary equilibria in ternary systems were derived from the minimum condition for the integral free enthalpy of formation. Special solutions are discussed as examples for certain models. The actual equilibria of the following systems were evaluated thermodynamically: uranium–thorium–carbon, uranium–zirconium–carbon, uranium–hafnium–carbon, uranium–niobium–carbon, uranium–tantalum–carbon, vanadium–molybdenum–carbon, vanadium–tungsten–carbon, niobium–molybdenum–carbon, and tantalum–tungsten–carbon. Further possibilities for the calculation of enthalpies of formation from experimentally determined phase equilibria are discussed. (auth)

22206 SORPTION OF HYDROGEN BY TITANIUM–ZIRCONIUM AND TITANIUM–MOLYBDENUM ALLOYS. V. V. Grushina and A. M. Rodin. Zh. Fiz. Khim., 37: 559-65(Mar. 1963). (In Russian)

The sorption of hydrogen by Ti–Zr and Ti–Mo alloys at pressures from 5 mm to 60 atm and the thermal stability of the resultant structures were investigated. It was found that Ti–Mo alloy can sorb large amounts of hydrogen at room temperature, this capacity being strongly dependent upon the state of cleanliness of the alloy surface. With a Mo content of the alloy from 0 to 50% the atomic ratio equals ca. 1.9 atoms hydrogen per metal atom and up to 2.8 atoms per atom Ti. On heating Ti–Zr and Ti–Mo alloys were shown to give up sorbed hydrogen more readily than does pure Ti. (auth)

22207 CONSTITUTION DIAGRAM OF RHENIUM–RUTHENIUM–OSMIUM SYSTEM. E. M. Savitskii, M. A. Tylkina, and V. P. Polyakova. Zh. Neorgan. Khim., 8: 146-8(Jan. 1963). (In Russian)

Microstructure and phase analysis of Re–Ru–Os alloys showed the maximum hardness point of 700 kg/mm² in alloys containing 60 at. % Os, 20 at. % Re, and 20 at. % Ru. The maximum hardness of binary alloys was found with 60 to 70% Os (450 to 550 kg/cm²). The Re–Ru–Os alloys possess continuous ternary hexagonal lattice solid solutions. (R.V.J.)

22208 CONSTITUTION DIAGRAM OF In–Se ALLOYS. G. K. Slavnova, N. P. Luzhnaya, and Z. S. Medvedeva (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 153-9 (Jan. 1963). (In Russian)

Thermal and x-ray phase analysis was used in developing an In–Se constitution diagram. Chemical compounds InSe, In_2Se_3, and In_3Se were prepared and analyzed. The melting points were found for InSe, 660 ± 10°; In_2Se_3, 900 ± 10°; and In_3Se, 540 ± 10°. The temperatures of polymorphous transformations are $\alpha \rightleftharpoons \beta$, 200 ± 10°; $\beta \rightleftharpoons \gamma$, 650 ± 10°; and $\gamma \rightleftharpoons \delta$, 750 ± 10°. (R.V.J.)

22209 STABILITY OF β SOLID SOLUTIONS OF ZIRCONIUM–MOLYBDENUM–IRON AND ZIRCONIUM–RHENIUM–IRON ALLOYS. L. A. Petrova. Zh. Neorgan. Khim., 8: 373-5(Feb. 1963). (In Russian)

Isothermal cross sections of tempered Fe–Mo–Zr and Fe–Re–Zr alloys at 900 and 1000° showed that alloys with 7.5 wt % Mo and 1 wt % Fe stabilized with a β phase while with less Mo it stabilized into $\beta + \omega$ phase even at 1300°C. Zirconium alloys with Re and Fe did not stabilize into β phase indicating that combined Fe and Re cannot stabilize β-zirconium. (R.V.J.)

22210 METAL–METAL HALIDE SYSTEMS OF GADOLINIUM AND YTTRIUM. Jack Everett Mee. Thesis, Ames, Iowa, Iowa State Univ. of Science and Tech., 1962. 58p.

The phase diagrams for the salt rich portions of the $GdCl_3$–Gd, GdI_3–Gd, and YI_3–Y systems were determined with the aid of thermal analysis, equilibrations, and X-ray powder patterns. Previously unreported phase transformations were found in GdI_3 at 740° and in YI_3 at 978°; the high temperature phases could not be stabilized at room temperature by rapid quenching from above the transition temperatures. In the $GdCl_3$–Gd system the solubility of the metal in the molten salt is only 1.0 (±0.5) mole % at the eutectic temperature of 601°, 2.0% at 670°, and 5.0% at 950°. However, a solid compound of stoichiometry $GdCl_{1.59\pm0.06}$ was found which melts incongruently to salt-rich melt and Gd metal at 632°. It displays a high gross resistance and is evidently a truly reduced halide. This surprising fact destroys the tradition of the high stability of the f^7 configuration (e.g., for Gd^{+3}) being the only consideration for probable oxidation states for lanthanides near Gd. The solubility of Gd in GdI_3 is 14.4% at the eutectic temperature of 825° with the limit of solubility at 14.6% at 900°. The intermediate phase, GdI_2, melts incongruently to salt-rich melt and Gd metal at 831°. The lustrous, brassy appearance and low gross resistance of the compound indicate that it is metallic in nature like the diiodides of La, Ce, and Pr and should be represented as $Gd^{+3}e^-(I^-)_2$. Thermal analysis indicated a phase transformation in GdI_2 at 670°. In the YI_3–Y system the eutectic composition is 11.6% Y at 948°; the limit of solubility is 12.1% at 965° and 14.7% at 1150°. No evidence was found for a lower iodide. (Dissertation Abstr.)

22211 MAGNETIC AND STRUCTURAL BEHAVIOR OF DYSPROSIUM–COBALT ALLOYS. John Dudley Wood. Thesis, Bethlehem, Penna., Lehigh Univ., 1962. 97p.

The magnetic and structural behavior of dysprosium–cobalt alloys was investigated. A partial Dy–Co phase diagram has been proposed based upon evidence obtained using metallographic, x-ray, thermal analysis, and electron microprobe analysis techniques. Seven compounds, Dy_3Co, "Dy_3Co_2," $DyCo_2$, $DyCo_3$, Dy_2Co_7, $DyCo_5$, and "$DyCo_9$," were observed. The precise stoichiometries of "Dy_3Co_2" and "$DyCo_9$" could not be determined. At least 3 eutectics were observed in this system. The magnetic behaviors of Dy–Co alloys were determined from –196 to 32°C at applied fields of 3000 or 4000 oersteds. At –196°C, the Co-

rich compounds (i.e., $DyCo_3$ and compounds higher in Co) appear to show complete antiparallel alignment of the Dy and Co magnetic moments. The Dy rich alloys appear to exhibit a behavior indicative of antiparallel alignment of Dy moments and parallel alignment of Co moments. (M.P.G.)

22212 THE ELECTRICAL CONDUCTIVITY OF α-Nb_2O_5 AND Nb_2O_4. Robert Frank Janninck. Thesis, Evanston, Ill., Northwestern Univ., 1962. 114p.

The electrical conductivity of α-Nb_2O_5 and Nb_2O_4 was measured by means of a standard four probe d-c technique as a function of both the composition over the entire range of homogeneity of the oxide phases and the temperature over the range 77 to 1273°K. The measurements were made on pressed and sintered specimens of known and constant composition. The conductivity data for both α-Nb_2O_5 and Nb_2O_4, along with literature values for NbO, are interpreted in terms of the standard band model proposed by Morin for the 3d transition metal oxides and used here for the 4d transition metal oxides. The 4d band of the Nb ions forms the conduction band, while the 2p band of the O ions forms the valence band. The forbidden energy gap between these two bands appears to be 4 ev wide. Located within this forbidden gap is a donor level (indicated by the sign of the thermoelectric power), which arises from the metal-excess defect. This defect may be either singly ionizable O ion vacancies or triply or quadruply ionizable interstitial Nb ions. In the fixed-composition data for heavily reduced α-Nb_2O_5, an exhaustion region at high temperatures permits the calculation of an absolute value for the mobility of electrons in the 4d conduction band to be made. The magnitude of the mobility is 0.4 cm^2/v sec and follows a $T^{-0.5}$ law. At lower temperatures, a thermally activated process is observed which is attributed to the excitation of electrons from the metal-excess defect. The excitation energy for the defect decreases as the concentration of defects increases according to the Meyer-Neldel rule. The values range from 0.3 to 0.003 ev. The outstanding characteristic of the Nb_2O_4 data is the transformation temperature at 1070°K, which is believed to be a magnetic interaction due to a collapsing of a split 4d band. The conductivity in Nb_2O_4, an n-type semiconductor, is independent of composition in the very narrow range of homogeneity. A close similarity of the electrical properties of the Nb oxides to those of the Ti oxides is observed, indicating that the same type of mechanism of conduction is probably occurring in both oxide systems. (Dissertation Abstr.)

22213 ELECTROMOTIVE FORCE MEASUREMENTS OF METAL–OXYGEN SYSTEMS. Kazuhiro Goto. Thesis, Columbus, Ohio, Ohio State Univ., 1962. 72p.

The standard free energies of formation of several metal oxides were determined by electromotive force measurements on reversible oxygen-concentration cells. Zirconia, stabilized with CaO, was used as the electrolyte. The O-concentration cell procedure was developed to allow the determination of the chemical activities of components in liquid metallic solutions. The activity of Sn in Pb–Sn solutions was determined in the temperature range of 700 to 900°C. The activity of Pb in the Pb–Sn solutions was calculated by using the Gibbs-Duhem equation, and the pertinent thermodynamic properties of the liquid Pb–Sn system were summarized. The system exhibits positive deviation from Roaultian behavior. An oxygen gage was designed for the purpose of measuring the partial pressure of oxygen in complex gas mixtures. Again, an oxygen-concentration cell with CaO–ZrO_2 electrolyte acted as the sensing device. The instrument was calibrated against Ar–O and CO_2–Co gas mixtures, and measurements were made to establish its usefulness. (Dissertation Abstr.)

22214 ATOMIC THERMAL VIBRATIONS AND BONDING EFFECTS IN GRAPHITE, DIAMOND, AND TITANIUM DIBORIDE. Mark G. Miksic. Thesis, Brooklyn, Polytechnic Inst., 1962. 117p.

The atomic thermal vibrations and characteristic temperatures of graphite, diamond, and titanium diboride have been determined from measurements of the Bragg intensities as a function of temperature in the range 100 to 300°K. Full three-dimensional data from spherical crystals of TiB_2 using MoKα radiation was used with some data from polycrystalline specimens in an attempt to observe bonding effects in titanium diboride. The Debye-Waller theory (DW) was used to obtain values of Θ and $\overline{\mu^2}$ for the Ti and B atoms along the principal directions of TiB_2 (a hexagonal crystal) as well as for diamond and for the "c" direction of graphite. A modified DW expression (MDW) was calculated for the "c" direction of graphite using the frequency-distribution of Krumhansl and Brooks. The results of these measurements are tabulated and discussed. The value of Θ (TiB_2) determined from x-ray-diffraction measurements (960 ± 30°K) is in good agreement with that calculated from the elastic constants (1003 ± 10°K). The total rms amplitudes at 300°K were determined by a least-squares calculation of the three-dimensional data. The total and thermal amplitudes for Ti are in good agreement while the total amplitudes for B are 0.006 Å above the thermal, signifying a larger temperature independent disorder for these atoms in the crystal. The physical properties of the transition metal diborides and the x-ray-diffraction studies of TiB_2 are studied to determine an appropriate bonding model. (M.P.G.)

Radiation Effects

22215 (AFSWC-TDR-62-118) THEORETICAL STUDY OF BURST-INDUCED TRANSIENT RADIATION EFFECTS IN BASIC ELECTRONIC CIRCUITS. J. E. Bell, R. H. Pizarek, R. L. Helms, and K. R. Walker (Hughes Aircraft Co., Fullerton, Calif.). Jan. 1963. Contract AF 29(601)-4743. 426p.

An analog computer was used in the theoretical investigation of transient radiation effects on five electronic circuits. Two of the circuits are normally linear. The other three circuits are non-linear. Linear mathematical models were used to represent the linear circuits. The non-linear circuit elements were represented by electronic curve followers. The circuits were investigated for response to simulated rectangular, Gaussian, and weapon-like radiation pulses. The responses were analyzed for indications of d-c and signal level change, phase shift, recovery time, and abnormal switching. Comparisons and correlations were made between the responses to the rectangular and time varying radiation pulses. All data, data reductions, comments, and conclusions regarding the weapon-like response are covered in a Secret-Restricted Data Supplement. Closed loop transistor amplifier, Wien-bridge oscillator, free-running multivibrator, 90° phase shift amplifier, and semiconductor diode detector circuits were analyzed. (auth)

22216 (BMI-1623) RELEASE OF FISSION GASES FROM UO_2 DURING AND AFTER IRRADIATION. James B. Melehan, Russell H. Barnes, John E. Gates, and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). Mar. 26, 1963. Contract W-7405-eng-92. 53p.

Sintered UO_2 specimens with densities 82, 92, and 99% of theoretical were irradiated in a beam tube of the BRR, and the fission gases released during irradiation were collected for gamma-ray spectrometric determination of release rates for several fission-gas isotopes. In-pile and out-of-pile release at temperatures to 1650°C was studied. At 1000 to 1650°C the diffusion coefficients for Xe^{133}, Xe^{135}, and Kr^{85m} were expressed by the relation $D = D_0 \exp(-Q/RT)$, where $D_0 = 2.0 \times 10^{-3}$ to 4.6×10^{-3} cm^2 per sec and Q = 87 to 92 kcal per mole. Below 1000°C, the in-pile gas release rates were relatively insensitive to changes in temperature, suggesting that diffusion was not occurring and that diffusion coefficients are of doubtful significance in describing gas release below about 1000°C under in-pile conditions. The experimental relation between gas release rate and the fission-gas half-life also suggest that below 1000°C diffusion was not the principal in-pile release mechanism. It was also observed that the release below 1000°C was not the result of only a simple recoil mechanism. The reasonable agreement between in-pile and out-of-pile diffusion coefficients above 1000°C suggests that for low burnups accurate diffusion data can be obtained during postirradiation annealing out-of-pile. For specimen densities in the range of 92 to 99% of theoretical the equivalent-sphere model for expressing fuel-surface geometry led to consistent results in analysis of gas-release by volume diffusion. (auth)

22217 (GA-3197) RADIATION STUDIES OF GRAPHITE-MATRIX FUEL BODIES CONTAINING $(Th,U)C_2$ FUEL PARTICLES. Walter V. Goeddel (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Nov. 16, 1962. Contract AT(04-3)-314. 38p.

Results of extensive irradiation testing of graphite-matrix fuel compacts are presented. The compacts containing uncoated $(Th,U)C_2$ particles were dimensionally stable after burnups of 6.9×10^{19} fissions/cm^3 at 1100 to 1500°C. Compacts containing coated particles were tested to burnups of 1.2×10^{20} fissions/cm^3 at temperatures as high as 2000°C. A few percent of the particle coatings were found to be broken after these tests. Possible explanations for these failures are presented. (auth)

22218 (GA-4164) TRANSIENT RADIATION EFFECTS. Final Report. D. M. J. Compton and R. A. Poll (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Apr. 12, 1963. Includes Appendices: A. CALCULATION OF HIGH-ENERGY SECONDARY ELECTRON EMISSION. J. A. Sawyer and V. A. J. van Lint. B. INTER-ELECTRON SCATTERING IN QUASI-INTRINSIC GERMANIUM AND SILICON. E. G. Wikner and J. Pereue. C. MECHANISMS OF TRANSIENT RADIATION EFFECTS IN ELECTRONIC PARTS. V. A. J. van Lint. Contract DA-49-186-ORD-939. 101p.

Transient conductivity induced in plastic films (Mylar was most frequently used) by pulsed irradiation was investigated. The conductivity displayed polarization effects, and means were devised to eliminate polarization effects from conductivity measurements. Use of several contact materials showed contact effects to be insignificant, at least for Mylar. Studies of voltage dependence and thickness dependence indicated, respectively, that conventional conductivity processes are involved and that both the delayed and prompt conductivity are bulk effects. Conductivity was found proportional to the radiation dose and was found to increase with radiation pulse width. Effects of electrons and gamma rays were compared, and conductivity produced by the two were comparable. The heating rate of an electron beam was found to be about 60% of that of a gamma ray beam producing the same conductivity signal. Lowering the temperature decreased the prompt conductivity, but left the delayed conductivity unchanged. Breakdown was found difficult to induce, and magnitudes of conductivity in several polymeric films were found to be quite similar. Induced conductivity in bulk insulators and insulating liquids was examined. Observed conductivities for several liquids are presented. Equipment for studying angular and energy dependence of secondary electron emission from irradiated materials was developed and tested. Some measurements were made. Space charge in electron beams during secondary emission and the buildup of electrons in a gamma ray beam were also examined. An absolute calorimeter was constructed for measuring the energy of gamma beams. Effects of heating were considered, and conductivity induced in nitrogen gas by pulses of 30-Mev electrons was measured. Papers on mechanisms of transient radiation effects in electronic parts and inter-electron scattering in quasi-intrinsic Ge and Si are included in appendices as well as the abstract of a paper on calculation of high-energy secondary electron emission. (D.C.W.)

22219 (GEAP-3771-6) HIGH PERFORMANCE UO_2 PROGRAM QUARTERLY PROGRESS REPORT NO. 6, JULY–SEPTEMBER 1962. B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., Cincinnati). Work performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 88p. (EURAEC-503)

The experiment for direct measurement of fission-gas pressure was terminated at the VBWR shutdown on September 12, 1962. Evidence indicated that practically 100% of the fission gas is released in that volume fraction of the fuel rod calculated to be operating at a temperature above 1700°C. Four irradiations were carried out in the GETR pressurized-water loop. All fuel rods in two assemblies irradiated showed marked swelling of the cladding. The extent of the swelling was directly related to the fuel rod thermal performance. A fuel assembly was fabricated with UO_2 pellets containing a small central hole in an effort to eliminate clad swelling. When UO_2 was heated in a tungsten crucible above 2800°C migration of tungsten into UO_2 and UO_2 into tungsten occurred. (M.C.G.)

22220 (IDO-16850) ORGANIC CAPSULE IRRADIATIONS IN THE MTR RABBIT FACILITY. J. R. McGeachin and S. Cohen (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 1, 1963. Contract AT(10-1)-205. 14p.

It is noted that several irradiations were completed in the MTR hydraulic rabbit system that proved the various capsule design principles. Information obtained in these experiments is presented concerning the design and preliminary irradiation work associated with the use of gamma heat to bring rabbit capsules to a desired temperature. (J.R.D.)

22221 (HW-67072) IRRADIATION OF ZIRCALOY-2 CLAD URANIUM RODS IN NaK-FILLED CAPSULES, GEH 3-31, 32, 57, 58, AND 59. Final Report. J. W. Weber (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1962. Contract AT(45-1)-1350. 52p.

Physical properties, particularly swelling in the temperature ranges 250–350 and 450–600°C, of Zircaloy-2-clad uranium were studied by irradiating five capsules, each containing a single fuel rod (0.630-inch-diameter) clad with 0.030-inch-Zircaloy-2. Dimensional and density measure-

ments were made along with metallographic observations. Design and fabrication of the elements, irradiation, and the results are discussed. Above 400°C, Zircaloy-2 displayed considerable volume increase while significant uranium cracking occurred at 450°C and above. Incongruencies were noted in the cladding strains under which the cladding failed. Uranium was observed to have entirely different properties during and after irradiation. Grain structure in uranium also appeared at 450°C and changed above 500°C. Above 400°C both intergranular and transgranular cracking occurred in uranium. Other microstructural features were observed. (D.C.W.)

22222 (MMPP-NPC-1-3) APPLICATIONS OF SPIN RESONANCE TECHNIQUES TO THE STUDY OF RADIATION EFFECTS. C. Kikuchi, S. Yip, and S. H. Chen (Michigan. Univ., Ann Arbor. Michigan Memorial-Phoenix Project). [1961]. 112p.

Fundamentals of the solid-state Zeeman effect are presented, and use of the phenomenon in studying the nature of crystal structure and defects in MgO; oxygen vacancies in MgO produced by neutron irradiation; neutron cross sections by spin resonance; nuclear spins, magnetic dipole moments, and electric quadrupole moments of certain iron group nuclides; and areas of solid-state chemistry is demonstrated. 50 references. (D.C.W.)

22223 (NAA-SR-7395) IN-PILE CAPSULE EXPERIMENTS TO DETERMINE THE EFFECT OF FAST NEUTRONS ON THE RADIOLYTIC DECOMPOSITION RATE OF TERPHENYLS. J. F. Zack, Jr., S. Berg, and N. M. Ewbank (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 15, 1963. Contract AT(11-1)-Gen-8. 37p.

An experimental program was conducted to determine whether fast neutrons are more damaging to terphenyl coolant than gamma rays, for equal amounts of energy absorbed. The program consisted of reactor capsule irradiations of a mixture of o-, m-, and p-terphenyl in the approximate weight ratio 1 : 5 : 2.8, to simulate Santowax OMP. Results indicate that, at 620°F and 30% decomposition product content, G(-coolant) for fast neutrons is 5.0 times as great as that for gamma rays. (P.C.H.)

22224 (NP-12732) RADIATION EFFECTS ON SEMICONDUCTORS AND SEMICONDUCTING MATERIALS: AN ANNOTATED BIBLIOGRAPHY. Helen B. McCormick, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Apr. 1963. Contract AF04(647)-787. 113p. (SB-62-47)

References and abstracts concerning radiation effects on semiconducting devices are presented. The bibliography reflects the technical literature issued during the period Jan. 1960 to July 1962. A total of 235 items is included. (J.R.D.)

22225 (REIC-25) THE EFFECT OF NUCLEAR RADIATION ON TRANSDUCERS. W. E. Chapin, D. J. Hamman, and E. N. Wyler (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Apr. 19, 1963. Contract AF33(616)-7375. 40p.

Information on the effects of nuclear radiation on various types of transducers that are becoming extremely important in present-day applications is presented. Information dealing with concepts and characteristics of conventional transducers with estimation of values of radiation thresholds is given. The approach used in the estimation involves contact with users and manufacturers for their opinions and knowledge on the subject, use of known experimental data for materials used in the fabrication of transducers, and some empirical data from experiments with similar units. Information is also included on research and development programs currently in progress or completed. Information from reports available at the Radiation Effects Information Center on irradiation of various transducers and sensing elements is presented. Force, gas and fluid-flow, acceleration, displacement, pressure, strain and torque, shock and vibration, liquid-level, and temperature transducers are considered. Other transducers and motion-sensing devices were examined. 55 references. (auth)

22226 (REIC-ACCESS-62(Pt.I)) RADIATION EFFECTS INFORMATION CENTER MONTHLY ACCESSION LIST. ABSTRACTS. PART I. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Apr. 15, 1963. Contract AF 33(657)-10085. 42p.

References (529) are given to journals and reports published from January 1961 through January 1963. Abstracts are also included. (P.C.H.)

22227 (TID-18577) CATALYTIC ACTIVITY AND NUCLEAR RADIATION. F. Nozaki, D. Stamires, and J. Turkevich (Princeton Univ., N. J. Frick Chemical Lab.). [1962]. Contract [AT(30-1)-937]. 34p.

The effects of gamma radiation on the catalytic activity of a synthetic alumina silica catalyst of the molecular sieve type and some gel type alumina, silica, and alumina silica catalysts were investigated. The catalytic reaction studied was the double bond migration in 1-butene. An electron spin resonance investigation was made of the materials before and after treatment with gamma radiation. It was found that the only effect of gamma irradiation on the active catalysts, the decationized molecular sieves, was to lower the activation energy. It was concluded that the irradiation had produced sufficient active sites to be experimentally seen in the inactive catalysts but not a sufficient number to compete with those already present in an active catalyst. (P.C.H.)

22228 (ZFK-WF-15) KORRELATIVE STOSSPROZESSE UND DIE ERZEUGUNG VON STRAHLENEFFEKTEN IN FESTKÖRPERN. (Correlative Collision Processes and Production of Radiation Effects in Solids). Manfred Balarin (Germany. Zentralinstitut für Kernphysik, Dresden). Mar. 1962. 21p.

Correlative elastic collision processes are possible in all simple crystal lattices. The minimum and maximum "hard sphere" diameters for the most important A lattice are given as focusing conditions. The origin of radioinduced lattice perturbations is discussed and compared with the earlier representations on collision cascades and perturbations areas. An essential significance in the production of radiation effects is in the direct and indirect focusing collision chains. This is especially true in the cases in which the energy of the primary atoms produced surpasses the displacement energy, E_d, by less than an order of magnitude. Relations between the mechanism of the energy transfer in solids, the type of defect arising, and the spatial distribution of these defects are discussed. (tr-auth)

22229 (EURAEC-560) EXAMINATION OF THE EFFECTS OF NEUTRON IRRADIATION ON THE PROPERTIES OF ZrNb3Sn1 ALLOY. Quarterly Report No. 2. Quarterly Report No. 2, October 1–December 31, 1962. (Metallgesellschaft, A. G., Frankfurt am Main). Jan. 21, 1963. Work Performed under United States–Euratom Joint Research and Development Program. 20p. A Translation.

The effects of various neutron irradiations on the me-

chanical properties and the degree of corrosivity of a Zr–Nb–Sn alloy were examined in a swimming pool reactor. The preparation of the test samples of Zr–Nb–Sn alloy and the Zircaloy-2 samples for comparative tests was continued, and a start was made with the examination of the mechanical and chemical/corrosive properties of the non-irradiated samples. The initial results show that the test material is of sufficiently uniform quality for the irradiation experiments and that the results are in good agreement with those of the earlier experiments. A start was made with the manufacture of the test sample holders, and a test autoclave for determining the effect of the γ-heating on the temperature differences in the irradiation autoclaves was prepared. (auth)

22230 LOW-TEMPERATURE IRRADIATION OF BERYLLIUM OXIDE. D. L. McDonald (Oak Ridge National Lab., Tenn.). Appl. Phys. Letters, 2: 175-6(May 1, 1963).

In an effort to determine if point defects produced in BeO by fast neutron bombardment were mobile at room temperature, a specimen was irradiated below 100°K; and thermal conductivity measurements were made in-pile during the irradiation and during a subsequent isochronal annealing study between 100°K and room temperature. Thermal resistivity increased linearly with fast neutron dose, and damage recovery started at 100 to 110°K and continued at about a constant rate up to maximum temperature. The results indicate defect mobility should be taken into account for below room temperature. (D.C.W.)

22231 RESISTIVITY OF DOPED IRON IRRADIATED WITH FAST NEUTRONS AT 78°K. Colette Minier-Cassayre and Daniel Dautreppe (Centre d'Études Nucléaires, Grenoble, France). Compt. Rend., 256: 2368-71(Mar. 11, 1963). (In French)

A study of the resistivity of doped iron (iron with very small additions of impurities) irradiated with neutrons at 78°K showed the sharp effect of Ni (in concentrations of 0.087 to 0.074 at. %) on the first annealing stages. Antimony, on the contrary, (in concentrations of 0.03 to 0.3 at. %) affects the last stages. (tr-auth)

22232 ELECTRICALLY STIMULATED CURRENTS IN IRRADIATED MONOCRYSTALS OF CADMIUM SULPHIDE. M. Borisov, St. Kynev, E. Vateva, and I. Georgieva. Compt. Rend. Acad. Bulgare Sci., 13: 23-6(1960).

The results of an analysis of electrically stimulated currents (ESC), which originated with the superimposition of voltage on a previously irradiated CdS crystal, are given. The magnitude of the currents depends in general not on the intensity of irradiation, but on its dosage. With an increase in dose the current increases up to a certain limit, beyond which saturation occurs. With the increase of the voltage applied to the crystal the current increases monotonically so that it is impossible in this way to detect the electron energy traps. Graphs of the electrically stimulated current against temperature exhibit 2 maxima (–80 and +80°C), showing different levels of electron traps. The positions of thermally and electrically stimulated electric current maxima coincide with each other which shows a close interdependence of the two phenomena. (Referativnyy zhurnal, Avtomatika i radioelektronika, No. 12, 1961)

22233 GAMMA RADIATION EFFECTS ON DIELECTRIC PROPERTIES OF INSULATING MATERIALS. III. AG-4 PLASTICS. B. I. Vorozhtsov, G. I. Potakhova, V. N. Nesterov (Tomsk State Univ., Siberian SSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 6, 143-6(1962). (In Russian)

Effects of γ radiation on (phenolformaldehyde resin base) AG-4 plastics were studied under various temperature and climatic conditions. Exposures to 670 r/min at –60, +20, and +200°C, 30 to 40 Hertz frequencies, and tropical humidity produced variations not exceeding 10%. Exposure to 2×10^3 r/min, with integral doses to 4×10^5 r/min, at 50 Hertz alternation did not influence the electrical resistance. Certain irreversible angular variations of dielectric losses were observed at elevated temperatures and low frequencies (at 30 Hertz and 200°C, variations of tg δ were 50%). (R.V.J.)

22234 EFFECT OF ATMOSPHERE ON RADIATION-INDUCED CROSSLINKING OF POLYETHYLENE. PART III. EFFECT OF VARIOUS GASES AND EFFECT OF ELECTRIC FIELD. Yoichi Okada (Sumitomo Bakelite Co., Ltd., Yokohama, Japan). J. Appl. Polymer Sci., 7: 1153-63(May 1963).

Polyethylene film was irradiated in various atmospheres, i.e., He, Ne, Ar, Kr, Xe, N_2, NO, NO_2, H_2O, CO, CO_2, CH_4, C_2H_6, C_3H_8, and C_4H_{10} by γ rays from a Co^{60} source. Xe, Kr, CO, and H_2O (vapor) accelerate the radiation-induced crosslinking as recently shown in case of N_2O. In addition, saturated hydrocarbon gases seem to be accelerative. NO depresses the crosslinking markedly and CO_2, mildly. On the other hand, NO_2 decomposes the polyethylene molecule without irradiation. Every other gas appears to be inactive. In relation to the effect of gas atmospheres, their solubilities in polyethylene were examined. N_2O is one of the most soluble of the inorganic gases. An electric field was applied to polyethylene film during irradiation. The degree of crosslinking evidently decreases with applied field, whether the atmosphere is N_2O or Ar. (auth)

22235 ELECTRON SPIN RESONANCE SPECTRA OF AGED, γ-IRRADIATED POLYSTYRENES. R. E. Florin, L. A. Wall, and D. W. Brown (National Bureau of Standards, Washington, D. C.). J. Polymer Sci., Pt. A, 1: 1521-9(May 1963).

The electron spin resonance spectrum of polystyrene that has been γ-irradiated at –196°C changes gradually with time from a broad three-peaked structure with outer derivative peaks at ±46 gauss to a much narrower structure with poorly separated outer derivative peaks at ±21 to 24 gauss. The deuterated polystyrenes behave likewise in general. The aged radicals of α,β,β-trideuterostyrene and β,β-dideuterostyrene exhibit only a single peak with derivative maxima at ±7 or 8 gauss from center. The aged spectra are all consistent with the hypothesis of major hyperfine interaction with β hydrogens. During the aging about 80% of the original radicals are lost, but the remainder are very long-lived. Poorly evacuated samples or those with added benzene decay much more rapidly. (auth)

22236 NUCLEAR RADIATION EFFECTS IN POLYTETRAFLUOROETHYLENE. D. E. Kline and J. A. Sauer (Pennsylvania State Univ., University Park). J. Polymer Sci., Pt. A, 1: 1621-6(May 1963).

Dynamic mechanical studies of polytetrafluoroethylene, subjected to a total reactor radiation dose of about 10^8 rads, showed that a decrease occurs in the height of the three damping peaks which are observed in unirradiated samples near 200, 300, and 400°K. Since the 200°K and 400°K peaks are associated with configurational changes in the amorphous regions of the material, the experimental observations are compatible with an increased degree of crystallinity. The effects observed in the dynamic modulus-temperature relation upon irradiation are consistent with

those found in the internal friction spectrum. The changes that occur in degree of crystallinity upon irradiation were studied by both infrared and density measurements, and an increase in crystallinity was found. The changes in the dynamic mechanical properties in the vicinity of room temperature are not well understood, but possible reasons for the observed behavior are given. (auth)

22237 RADIATION DEGRADATION OF POLYMETHACRYLATES. DOSE RATE AND MEDIUM EFFECTS. A. R. Shultz, P. I. Roth, and J. M. Berge (Minnesota Mining and Mfg. Co., St. Paul). J. Polymer Sci., Pt. A, 1: 1651-69(May 1963).

γ-Irradiations of polymethyl methacrylate (PMMA) powders confirm observations in literature that air retards the radiation-induced molecular weight lowering of this polymer. The energy absorptions per scission E_d are 91 ev in air at 0.117 Mreps/hr, 76 ev in air at 0.70 Mrep/hr, and 56 ev in vacuum at 0.117 Mrep/hr. γ-Radiation degradation of PMMA solutions (5 gm. PMMA/100 ml solvent) in butanone and in ethyl acetate gave apparent energies per scission of 63 ev and 26 to 30 ev, respectively. The latter low value is not understood. Poly-n-butyl methacrylate (PNBMA) displays considerable sensitivity to air and dose-rate effects during γ-irradiation. Apparent energy absorptions per main-chain scission observed for γ-irradiated PNBMA powder are: E_d = 454 ev in air at 0.117 Mrep/hr and E_d = 226 ev in vacuum at 0.117 Mrep/hr. The latter value is far above the E_d (146 ev) observed for electron-irradiated PNBMA film. To decrease possible chain recombination and/or polymer-polymer crosslinking reactions, degassed solutions of 4.5, 10.0, and 55 wt % PNBMA in ethyl acetate were γ-irradiated. Apparent E_d values of 74, 74, and 226 ev, respectively were found. Thus, the more dilute solutions give PNBMA scission energies near that of bulk PMMA. The 55 wt % PNBMA solution gives a scission energy indistinguishable from that of bulk PNBMA under the same irradiation conditions. Competitive crosslinking and main-chain scission are postulated for electron-irradiated poly-n-alkyl methacrylates. The energy per main-chain scission is assumed constant for all the homologs. The ratio of crosslinked units to chain scissions, α/β, is then found to increase linearly with $(n-1)$, where n is the number of carbon atoms in n-alkyl groups of the side chain. This scheme yields a consistent explanation of the radiation response of the lower members of the poly-n-alkyl methacrylate homologous series. A comparison of light-scattering $\overline{M}_w$ and solution viscosity $(\overline{M}_w)_v$ molecular weight changes did not reveal the concurrent crosslinking in PNBMA films undergoing chain scission by 1 Mev-peak electron irradiation. Some inquiry is made into the theoretical sensitivity of this comparison method. (auth)

22238 DEGRADATION OF A POLYCARBONATE BY IONIZING RADIATION. J. H. Golden and E. A. Hazell (Ministry of Aviation, Waltham Abbey, Essex, Eng.). J. Polymer Sci., Pt. A, 1: 1671-86(May 1963).

The degradation of a polycarbonate by electron irradiation in oxygen and in vacuum was examined. It was found that the polymer undergoes chain scission and that crosslinking apparently did not occur; the molecular weights of irradiated specimens were therefore determined from the intrinsic viscosity of methylene chloride solutions. From the relationship of molecular weight to radiation dose the value of G (scissions per 100 ev of energy absorbed) was found to be 0.14 in oxygen and 0.09 in vacuum. The effect of both molecular weight and radiation dose on the mechanical properties of polycarbonate irradiated in vacuum was studied. Conventional tensile properties were examined, and fracture energies were also obtained by use of a tensile impact apparatus based on the flywheel principle which was used to strain the specimens at 340 in./sec. With increase in radiation dose, the maximum yield strength and extension fall slowly at first and then rapidly at a dose of approximately 100 Mrad. The elastic modulus is, however, virtually unaffected by irradiation and the attendant changes in molecular weight. The fracture energy falls steadily with radiation dose, and from the results a linear relationship, $F = 0.0044\ \overline{M}_v - 59$, between fracture energy F and molecular weight $\overline{M}_v$ was obtained over the range examined, the energy becoming immeasurably small at molecular weights below 13,500. The results suggested that in this case fracture energy was a better measure of residual strength after irradiation than other tensile properties. The chemical changes caused by radiation lead to greatly enhanced ultraviolet light absorption with a maximum at 305 mμ and a shoulder at 320 mμ. The absorption (E; 1%, 1 cm), in oxygen and in vacuum was shown to be a linear function, $E = 0.020\ R + 0.32$ of the radiation dose R. The changes in the infrared spectrum, in particular the carbonyl absorption, of irradiated specimens are discussed. Mass spectrographic measurements showed that degradation proceeded with evolution of H_2, CO, and CO_2, both in oxygen and in vacuum. (auth)

22239 THE MODERN STATE OF THE STUDIES ON THE NATURE OF RADIATION DAMAGES IN SOLIDS. S. T. Konobeevskii (Joint Inst. for Nuclear Research, Dubna, USSR). Kernenergie, 6: 49-55(Feb. 1963). (In German)

Studies of the effects of radiation on solids are reviewed. Emphasis is placed on the effects of fast charged particles on crystal structure. (M.C.G.)

22240 THE DESIGN OF TECHNICAL RADIATION SOURCES CONSIDERING RADIATION EFFECTS AND CONVENTIONAL WEAR. K. H. Waechter (Frieseke and Hoepfner GmbH, Erlangen, Ger.). Kerntechnik, 5: 103-7(Mar. 1963). (In German)

Radiation doses to the constituent materials of technical radiation sources are estimated. Criterions were established concerning density of solid and gaseous sources, as well as of those which are activated together with the envelope. The demand for minimum wear of the envelope leads to certain design principles. When considering the corrosion effects, the chemical radiation reactions in the environment of the source and in the active substance should be considered, too. A typical accident is described. (auth)

22241 DESIGN FOR SPACE-2. RADIATION VS. MATERIALS. Edward J. Rohrbach and Howard S. Goldstein (Cutler-Hammer Inc., Long Island, N. Y.). Machine Design, 34: 148-50(Nov. 8, 1962).

The effects of space radiation on metals and plastics are described and proper selection of materials to minimize damage is discussed. (auth)

22242 PERSISTENT INTERNAL POLARIZATION OF INSULATORS INDUCED BY ELECTRON BOMBARDMENT. D. J. Gibbons (Research Labs. of Electrical and Musical Industries, Ltd., Hayes, Middx., Eng.). Nature, 198: 177 (Apr. 13, 1963).

Investigations were made of persistent internal polarization induced by pulses of electron bombardment on targets consisting of a layer of insulator 0.3 to 1.0 μ thick produced by vacuum evaporation and sandwiched between Al contacts 0.1 μ thick. The insulator was polarized in the presence of a bias field by bombarding with a predeter-

mined number of electron pulses of energy 2 to 25 kev. The polarization was investigated by reducing the bias to zero and measuring the displacement current due to the motion of carriers released from traps by further electron pulses. The electron beam energy was the same both for polarizing and depolarizing the specimen. Effects on specimens of ZnS, ZnCdS, and As_2S_3 are reported. Two independent exponential decays were identified. (C.H.)

22243 RADIATION-INDUCED FRAGMENTATION OF FISSILE OXIDES IN AQUEOUS SUSPENSION. H. S. G. Slooten (Keuring van Electrotechnische Materialen, N. V., Arnhem, Netherland) and R. G. Sowden. Nature, 198: 369-71(Apr. 27, 1963).

Fragmentation of the oxide particles was observed in aqueous suspensions of PuO_2 and in solid solutions of $(Th,Pu)O_2$ and $(Th,U)O_2$ following neutron exposure. Electron micrographs are shown of particles before and after irradiation. Possible mechanisms involved in radiation-induced fragmentation of fissile oxides are discussed. (C.H.)

22244 RANGE-ENERGY RELATIONS FOR PROTONS AND ALPHA-PARTICLES IN VARIOUS EXPLOSIVES. Joseph Cerny, Maurice S. Kirshenbaum, and Roger C. Nichols (Picatinny Arsenal, Dover, N. J.). Nature, 198: 371-2(Apr. 27, 1963).

Differential energy loss and range data were calculated for low and medium-energy protons and α particles in various explosives. The explosives include cyclonite; cyclotetramethylene tetranitramine; 2,4,6-trinitrotoluene; pentaerythritol tetranitrate; 2,4,6-trinitrophenyl methyl nitramine; lead styphnate; mercury fulminate; and lead azide. (C.H.)

22245 THE SIGNIFICANCE AND METHODS OF EXPERIMENTAL TECHNIQUES IN TEST REACTORS AND HOT LABORATORIES. PART II. N. H. Hancock (United Kingdom Atomic Energy Research Establishment, Harwell, Berks, Eng.). Neue Tech., 5: 107-28(Mar. 1963). (In English)

Metallurgical irradiation experiments performed in the Harwell research reactors are reviewed and the most useful types of equipment and techniques that are being used are described. Types of rigs that are being developed and the latest design thoughts are discussed. Experience on fissile, non-fissile, and loop experiments, together with instrumentation, dosimetry, and staff requirements are stated. (auth)

22246 THE INSTALLATIONS FOR PERFORMANCE AND INVESTIGATIONS OF IRRADIATION EXPERIMENTS IN HOT ISOTOPE LABORATORIES AT WÜRENLINGEN. P. Graf (EIR, Würenlingen, Ger.). Neue Tech., 5: 128-39 (Mar. 1963). (In German)

The hot cells of the hot laboratory at the reactor center Würenlingen and their remotely controlled installations for mechanical, metallurgical, and chemical investigations of active materials are described. The possibilities and restrictions of the equipment and apparatus for remotely controlled operations for post-irradiation examination of irradiation experiments are outlined and comments are given some of the requirements of the construction of irradiation rigs. (auth)

22247 METHODS OF POST-IRRADIATION EXAMINATION. H. Schumacher and M. Stauffer (EPUL, Institut Federal de Recherches en Matiere de Reacteurs, Würenlingen, Ger.). Neue Tech., 5: 140-52(Mar. 1963). (In French)

The problems of planning and organization of an irradiation experiment are briefly discussed and then general technical problems are mentioned which arise from the necessity of handling irradiated highly radioactive specimens in heavily shielded cells. Special techniques and working methods, which are used for hot cell manipulation, are described in connection with some operations of post-irradiation examination. Some methods of metallurgical, physical, and chemical examination are also discussed, with more details given on the different methods of burnup determination and on the techniques which allow work to be done outside of hot cells. (auth)

22248 STAGE III RECOVERY IN NEUTRON IRRADIATED MOLYBDENUM AND NIOBIUM. D. E. Peacock and A. A. Johnson (Imperial Coll. of Science and Tech., London). Phil. Mag., (8), 8: 563-77(Apr. 1963).

Molybdenum and niobium wires 1 mm in diameter were irradiated to epithermal neutron doses of 1, 2, 3, and 4×10^{19} nvt at a temperature of about 40°C. The thermal recovery of the increases in electrical resistivity caused by the irradiations was studied by plotting isochronal recovery curves for each neutron dose and metal. These curves revealed recovery stages at about 160°C for molybdenum and 120°C for niobium. From the results of isothermal recovery measurements it was found that the associated activation enthalpies were 1.25 ± 0.08 ev for molybdenum and 1.22 ± 0.02 ev for niobium. In both cases a plot of the magnitude of the recovery stage against the neutron dose showed a maximum at a dose of about 3×10^{19} nvt. The interpretation of these recovery stages is discussed in terms of a model in which the defects responsible for the recovery, which are probably lattice vacancies, diffuse either to interstitial impurity atoms, where they are trapped, or to defect clusters created by the irradiation, where they are annihilated. In lightly irradiated specimens trapping by interstitial impurities is believed to be the dominant mechanism, but annihilation at clusters probably becomes more important as the neutron dose increases. (auth)

22249 EFFECTS OF REACTOR RADIATIONS ON THE CHEMISORPTION EQUILIBRIUM OF OXYGEN ON NICKEL OXIDE. I. Maxim and T. Braun (Inst. of Atomic Physics, Bucharest). Phys. Chem. Solids, 24: 537-48(Apr. 1963). (In English)

On irradiating non-stoichiometric nickel oxide — in vacuum — in a nuclear reactor, it was found that the amount of surface oxygen (determined by iodometric titration) increases. The greater the initial non-stoichiometry of the irradiated oxide, the greater this increase. The catalytic activity of the nickel oxide in the decomposition of hydrogen peroxide also increases as a consequence of the irradiation. The radioinduced effect is annealed after a thermal treatment. The activation energy of this annealing process is 0.8 ev. Both the appearance and annealing of the effect observed are explained on basis of the presence, on the nickel oxide surface, of some weakly bound forms of oxygen, in keeping with Wolkenstein's theory. (auth)

22250 PARAMAGNETIC RESONANCE OF IRRADIATED FERROELECTRIC $LiN_2H_5SO_4$. R. Blinc, M. Schara, and S. Poberaj (J. Stefan Inst., Ljubljana, Yugoslavia). Phys. Chem. Solids, 24: 559-62(Apr. 1963). (In English)

The electron spin resonance spectra of γ-ray damaged ferroelectric lithium hydrazinium sulphate (LiHzS) and deuterated LiHzS were studied. A comparison of experimental and theoretical resonance patterns indicated that: (a) the

principal impurity centers produced by γ rays in LiHzS and deuterated LiHzS are $\dot{N}_2H_4^+$ and $\dot{N}_2D_4^+$, respectively; (b) the unpaired electron spin densities on both nitrogens are nearly equal to each other, and the charge distribution has local cylindrical symmetry about both nitrogen nuclei; (c) the approximate values of the isotropic and anisotropic nitrogen hyperfine coupling constants are $A_1 = 14$, $A_2 = 12$, and $B_1 = 8$, $B_2 = 7$ G, respectively. (auth)

22251 COLOR CENTERS IN ALKALINE EARTH FLUORIDES. J. R. O'Connor (Massachusetts Inst. of Tech., Lexington) and J. H. Chen. Phys. Rev., 130: 1790-1(June 1, 1963).

Several experiments are presented dealing with color centers in alkaline earth fluorides. Evidence for simple color centers is not observed. Color centers previously reported in CaF_2 are due to the contamination of fluoride with Y. The optical and electron paramagnetic resonance spectra of $Y^{2+}(4d^1)$ are discussed. (auth)

22252 CASCADE THEORY OF DEFECT PRODUCTION. D. Heinrich and R. Lenk (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Phys. Status Solidi, 3: 676-91(1963). (In German)

The basic assumptions of cascade theory are discussed, and a very general angular-dependent formulation of this theory was developed which contains, apart from the threshold energy, a further energy parameter. Angular integration then gives the continuous displacement probability. This general model contains as special cases most of the models discussed by other authors, and, therefore, interpolation is possible. The general continuous displacement probability can be reduced mathematically to give a sharp threshold energy. This procedure is quite general and allows a physical interpretation. As a test case the hard-core approximation for the scattering law was applied to the present theory. (auth)

22253 ELECTRON PARAMAGNETIC RESONANCE STUDY OF THE EFFECT OF IONIZING RADIATION ON GLASSES BELONGING TO THE $Na_2O \cdot B_2O_3 \cdot SiO_2$ SYSTEM. G. O. Karapetyan and D. M. Yudin (Vavilov State Optical Inst., Leningrad). Soviet Phys.-Solid State (English Transl.), 4: 1943-9(Apr. 1963).

The electron paramagnetic resonance (EPR) method was used to make a study of glasses of the sodium borosilicate system, exposed to the γ radiation from Co^{60}. It was shown that color centers can exist in this system associated with at least four different structural networks. Each center has its own lines in the EPR spectrum: $\alpha_1 - [SiO_2]$; $\alpha_2 - [SiO_2 \cdot 2Na_2O]$; $\beta_1 - [BO_3]$; $\beta_2 - BO_4$]. It was definitely shown by $B^{11} \rightarrow B^{10}$ isotope replacement that capture centers exist in borate and borosilicate glasses, associated with the boron. For comparison with the EPR spectra, optical spectra are given showing the additional absorption of γ-irradiated sodium borosilicate glasses. (auth)

22254 POTASSIUM ION BOMBARDMENT-INDUCED CONDUCTIVITY IN GERMANIUM. I. A. Abroyan (Kalinin Polytechnic Inst., Leningrad). Soviet Phys.-Solid State (English Transl.), 4: 1994-9(Apr. 1963).

An investigation of the additional conductivity imparted to germanium subjected to bombardment by high-energy potassium ion beams is presented. The bombarding particle energies were varied between the limits 100 and 10,000 ev. The possible causes of this ion-bombardment-induced change of conductivity are discussed. The number of electrons excited into the conduction band and the probability of their emission into the vacuum were determined from the experimental data. (auth)

22255 DISTRIBUTION OF DISPLACED ATOMS IN A SOLID DUE TO A PRIMARY ATOM GENERATED BY IRRADIATION. A. Korchovei, G. Gika, and D. Greku (Inst. of Atomic Physics, Bucharest). Soviet Phys.-Solid State (English Transl.), 4: 2037-44(Apr. 1963).

A study is made of the spatial distribution of atoms displaced by a primary atom generated by radiation and having a fixed energy and a known initial direction. Mean values are calculated for the products of the different powers of the components of the final position of the primary atom. For this purpose a correlation function is introduced for the distribution of the successive displacements of the primary atom that takes into account the possibility of the atom stopping in case its energy becomes less than E_d. Further, an elegant matrix method is used to find the recurrence formulas for the quantities corresponding with the nth displacement with respect to the (n-1)st displacement, which are expressions leading to Volterra integral equations in the case where n takes on very large mean values. These values are used to calculate the distribution function of the atoms displaced by a primary atom, that in the third order of approximation differs somewhat from a three-dimensional Gaussian function. (auth)

22256 ENERGY SPECTRUM OF A γ-RADIATION DEFECT IN SILICON. N. A. Vitovskii, T. V. Mashovets, and S. M. Ryvkin (Leningrad Physicotechnical Inst.). Soviet Phys.-Solid State (English Transl.), 4: 2085-7(Apr. 1963).

A study was made of the temperature dependence of the Hall coefficient of n and p-type silicon samples before and after irradiation with Co^{60} γ rays. Two radiation-defect levels were found in the upper half of the forbidden band and one in the lower half. The activation energies and formation cross sections of these levels were determined. (auth)

22257 EFFECT OF THE BREMSSTRAHLUNG RADIATION FROM A 25-Mev BETATRON AND OF 14-Mev NEUTRONS ON THE ELECTRICAL CONDUCTIVITY OF POLYMERIC DIELECTRICS. A. P. Bazin. Soviet Phys.-Solid State (English Transl.), 4: 2113-16(Apr. 1963).

Film specimens of five polymeric dielectrics used as electrical insulating materials were irradiated in a vacuum capacitor. The volume resistivity of the investigated polymeric dielectrics placed in a beam of bremsstrahlung radiation from a betatron (60 r/min at a distance of 1 m) decreases discontinuously by two to three orders of magnitude and following the cessation of radiation it increases to a new value dependent on the half-day dosage. Neutron effects are also reported. (auth)

22258 EFFECT OF GAMMA RADIATION ON OXIDE CATALYSTS AND ON SYSTEMS CONSISTING OF A CATALYST AND ADSORBED HYDROCARBON. Yu. A. Kolbanovskii, I. M. Kustanovich, L. S. Polak, and A. S. Shcherbakova (Inst. of Petrochemical Synthesis, Academy of Sciences, USSR). Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 1: 191-2(1961).

The EPR spectra of a series of catalysts were studied before and after irradiation with ~1.25-Mev Co^{60} γ quanta. Attempts were made to find out whether carriers of unpaired-electrons exist in the polycrystalline samples, and the interaction between hydrocarbon (and/or the radiolysis product) and the catalyst during adsorption was also studied. Aluminum oxide, aluminum silicate cracking catalyst, potassium oxide-promoted chromo-alumina catalyst, molybdeno-alumina catalysts, molybdenum disulfide, and cobalto-molybdeno alumina catalysts were used. Only $Cr_2O_3 \cdot Al_2O_3$ released a signal in the EPR spectrum prior to irradiation. After irradiation at 20°C

all catalysts with aluminum oxide content released a distinct signal. Its position and width correspond to that of the aluminum oxide signal. The adsorption of hydrocarbons (heptane, 1-heptene, cyclohexane, and benzene) at 20°C did not change the resonance spectra. At −196°C heptane adsorption on molybdenum sulfide caused two high peaks in the resonance spectrum at both sides of g-2.0033. At −196°C the same phenomenon was observed in all hydrocarbons. Irradiation of a system consisting of a catalyst and adsorbed hydrocarbon not only releases the aluminum oxide signal but also a more intense signal with $g < 2$. This indicates an electronic interaction between the hydrocarbons that had been subject to radiolysis in the adsorbed state and the surface of the catalysts that contained metal oxides of variable valence. (TCO)

22259 VARIATION OF ABSORPTION BANDS IN THE SPECTRUM OF DYED POLYMETHYL METHACRYLATE UNDER THE ACTION OF GAMMA RAYS. L. G. Keytlin and S. V. Starodubtsev (Physicotechnical Inst., Academy of Sciences, Uzbekskain SSR). Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 1: 279-81(1961).

The color change of thin polymethyl methacrylate plates was studied under the action of gamma rays using benzene-azo-α-naphthylamine as the dyestuff. To study the effect of admixtures, both plates without admixtures, and with dichloroethane or benzene, were used. They were irradiated in vacuo at a dose rate of 3.5×10^5 r/hr. Under irradiation of the dyed polymethyl methacrylate plates produced by photopolymerization (dyestuff added immediately before polymerization), there was a gradual decline from the initial peak at 440 mμ, a new peak appearing at 550 mμ. This was strongest at 1.7×10^7 r and fell again with further increase in dose. The absorption spectra show that plates with dichloroethane have the more distinct maxima. The agreement of the maxima shows that, if acid is added, the indicator in polymethyl methacrylate will behave the same during irradiation as without. It is suggested that the protons and electrons released during irradiation are bound to the dyestuff, thus causing the color change. (TCO)

22260 A MAGNETIC AFTER-EFFECT FOR NEUTRON IRRADIATION OF NICKEL SINGLE CRYSTALS. Horst Reger (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Z. Metallk., 54: 229-39(Apr. 1963). (In German)

The after-effect of the reversible susceptibility of neutron-irradiated nickel single crystals was investigated. The reversible susceptibility decreased logarithmically in the parts of the magnetization curve in which magnetization changes by motion of Bloch walls. The dependence of the relaxation amplitude on temperature, magnetization, and on the recovery behavior indicated that there is neither an orientation nor a diffusion or thermal after-effect. A possible reason for the after-effect can be thermally activated creep of Bloch walls. A relationship was deduced which describes quantitatively the dependence of the after-effect on time, temperature, and field strength. This model can also explain the dependence of the after-effect on magnetization, plastic deformation, and recovery on a qualitative basis. The recovery behavior indicated that the after-effect is caused by single or small groups of point defects, but not by dislocations. (auth)

PHYSICS

General and Miscellaneous

Refer also to abstracts 21830, 21832, 21837, and 22281.

22261 (62GL36) TRANSIENT THERMODYNAMIC ANALYSIS. Dale H. Brown (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Mar. 8, 1962. 67p.

This is a reissue of 56GL316.

A system of generalized thermodynamics is presented with particular emphasis on transient thermodynamics. A methodology that permits analysis of specific apparatus and processes by elimination of needless terms is established. Non-flow and steady-flow relations are derived from the simplified model of generalized thermodynamics. Several examples of transient analysis are presented, and complex system analysis is examined. Reactor transient thermodynamics and steam turbine dynamics are treated in terms of the transient thermodynamics approach. (D.C.W.)

22262 (AD-284662) THE CONVERSION OF HEAT TO ELECTRICAL POWER BY MEANS OF A CHARGED AEROSOL. Quarterly Report No. 4, April 1, 1961 through June 30, 1961. (Marks Polarized Corp., Whitestone, N. Y.). Nov. 14, 1961. Contract NOw 60-0831-c. 66p.

The electrothermodynamics of an electric generator utilizing a charged aerosol was investigated for single and multiloop Carnot cycles. Parameters related to efficiency were established for pressure, temperature and isothermal and isentropic work. The charged aerosol is a new working substance uniquely adaptable to a variety of controlled electrothermodynamic operations. Heat interchange is facilitated between the highly dispersed liquid and gas components of the aerosol. The liquid/gas mass ratio of a charged aerosol controls the modes of operation during expansion or compression, thus enabling the predetermination of isothermal or isentropic operation, by adjusting the liquid/gas mass ratio. Electrical power is extracted during both isothermal and isentropic expansion of the charged aerosol. Compression may be effected by the reverse electrodynamic effect. Utilizing these principles, new multiloop aerosol cycles having an overall efficiency of 60 to 80% appear feasible. (auth)

22263 (AFCRL-62-669) PARAMETRIC STUDY OF CLOSE-SPACED CESIUM THERMIONIC CONVERTERS. Annual Technical Report. E. N. Carabateas, S. Kitrilakis, and J. H. Weinstein (Thermo Electron Engineering Corp., Waltham, Mass.). May 1962. Contract AF19(604)-8453. 82p. (AD-282895)

A variable spacing, Cs diode test vehicle, using a Nb emitter and Mo collector, was used for parametric tests of converter performance. The design and construction of the test vehicle were such that emitter temperature, collector temperature, and Cs pressure could be independently controlled. In addition, most of the important converter heat losses could be accurately measured. Extensive tests were conducted which resulted in a complete map of diode performance. Additional tests were conducted to supply data for analytical work on Cs conduction, converter operation, and surface phenomena. (auth)

22264 (ANL-6679) PHYSICS DIVISION SUMMARY REPORT, JANUARY–FEBRUARY 1963. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 93p.

A short chronological summary of the tandem Van de Graaff accelerator project and a summary of the tandem acceptance tests are given. The previously identified doublet near 245 kev in Se^{77} was studied by Coulomb excitation and pulsed-beam techniques. The mean life of the weakly excited upper level at 249 kev was found to be 13.2 ± 1.2 nsec, so that it could be easily separated from the very short lived but strongly excited lower level. The relative intensities of the various de-excitation gamma rays were measured, and the $B(E2)_{exc}$ of the 249-kev level was found to be $(1.25 \pm 0.25) \times 10^{-50}$ e^2cm^4. For the study of excited states of light nuclei, a procedure was developed that enables either the particle width $\Gamma_{\alpha 1}$ or the total width Γ to be determined from elastic-scattering experiments when the target thickness T (in energy units) exceeds Γ. Absolute differential cross sections for the reactions Ca(d,d)Ca and Ca^{40}(d,p)Ca^{41} were measured. These results are a test for distorted-wave Born-approximation calculations of the stripping reaction. Fluctuations in the excitation functions for elastic scattering of protons from Ni^{58} were studied with thin and thick targets. The results disagree with some of the expectations from the statistical model. The gamma-ray spectrum from neutron capture in Ca^{44} was observed with a scintillation spectrometer having an anticoincidence annulus. Two spectrometers were used in coincidence to study the decay scheme. Some preliminary data are reported. The scintillation spectrometer with an anticoincidence annulus of NaI was used to measure the energies of the 2p-1s transitions in mu-mesonic atoms with $7 \leq Z \leq 30$. About half of the data were analyzed, and these results are reported. The ionization of several of the rare gases and lower hydrocarbons by protons with energies from 0.80 to 3.75 Mev was studied by mass-spectrometric methods. The portable mass spectrometer used for these investigations is described. Partial cross sections for production of rare gas ions in various charge states were determined for this energy region. A method is proposed for the analysis of measured energy distributions of ionic fragments resulting from electron impact on polyatomic molecules. The symmetric family of saddle-point shapes for charged liquid drops was determined for values of the fissionability parameter x between 0.3 and 1.0. A transitional region in the neighborhood of $x = 0.67$ was found. For x smaller than this value, the saddle-point shapes are dumbbell-like; for larger values they are cylinder-like. For x values larger than 0.39 the saddle point is found to correspond to a threshold for fission. For values smaller than 0.39 the saddle point is an unstable equilibrium point with respect to asymmetric distortions and therefore no true threshold exists. Nuclear reactions are discussed by use of a dispersion-theory type formalism, and resonances are defined by the poles of an analytic continuation of the imaginary part of the reaction amplitude. The result is an ordinary Breit-Wigner type resonance, but it is obtained without the need for an "internal" Schrödinger equation with artificial boundary conditions at a "nuclear radius." The model of Byers and Yang is extended to describe the current-carrying state in a thin superconducting ring, by including the magnetic interaction in the zero-order hamiltonian. The induced magnetic field is treated self-consistently. Pairing degeneracy occurs for any value of the surrounded flux, but self-consistency is obtained only for quantized values of the flux. The irreducible repre-

sentations of the inhomogeneous Lorentz group that describe respectively particles with and without mass are qualitatively different. Nevertheless, the zero-mass representations can be obtained from the representation with mass by letting the mass go to zero. Particles of sufficiently small mass or sufficiently high energy behave like particles of zero mass. The basic postulate of quantum mechanics is the superposition principle. It has been felt by many, including this author, that a more directly verifiable, operational postulate would be more satisfactory. A new approach to the problem of "operational formulation of the foundations of quantum mechanics" is proposed here. (auth)

22265 (ASD-TDR-63-183) EVALUATION OF A MOLYBDENUM EMITTER, LOW VOLTAGE ARC THERMIONIC POWER CONVERTER. E. A. Baum (General Electric Co. Power Tube Dept., Schenectady, N. Y.). Feb. 1963. Contract AF33(657)-8323. 100p.

Results of life tests on the planar molybdenum-emitter cesium-vapor thermionic converter operating under steady-state conditions are presented along with a description of the life-test equipment. Transient data on the effect of variations in cathode, anode, and reservoir temperatures, as well as step changes in the load, are also presented. The steady-state life tests were performed at a cathode temperature of 1450°C on a 5 cm^2 cathode area converter design with the thermal input being supplied by a radiation-type furnace in order to more closely simulate solar cavity heating. Seven converters were tested for extended periods with nominal power outputs of 1.5 watts/cm^2 to 2.5 watts/cm^2. The maximum life of the state-of-the-art structure on one converter was in excess of 3000 hours and four converters were operated beyond 1000 hours without major degradation in the power output. In addition, the analyses of two converters that operated for 1200 hours and 1400 hours are discussed. (auth)

22266 (BM-IC-8166) X-RAY MASS ABSORPTION COEFFICIENTS. A Literature Survey. Howard M. Stainer (Bureau of Mines. College Park Metallurgy Research Center, Md.). Oct. 1962. 128p.

Published x-ray mass absorption coefficients were compiled and tabulated. Values are listed for 87 elements with both experimental and calculated points included; the wavelengths range from ~0.01 to 68 Å. Representative graphs are presented for six elements (Li, N, Fe, Ag, Ho, and U). 65 references are also included. (P.C.H.)

22267 (BSD-TDR-62-116) THEORETICAL AND EXPERIMENTAL STUDY OF AN UNPROTECTED SUPERCONDUCTING COIL GOING NORMAL. Research Report 135. Z. J. J. Stekly (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). May 1962. Contract AF04(694)-33. 35p. (AD-282994)

A theoretical analysis for the propagation of the normal region in a series wound superconducting coil without protective circuitry is presented. The propagation of the normal region is expressed as a variable resistance with time, allowing the solution of the electrical circuit equations to yield the current, voltage across the normal region and the local energy dissipation during the decay transient. Good agreement of the predicted currents and voltages with experimental results is obtained. The effect of coil energy, as well as metal coating on the conductor on the voltages and on the energy dissipated per unit length of wire at the initial normal point during the decay transient, are evaluated. (auth)

22268 (IS-409) PRESSURE-VOLUME-TEMPERATURE-MEASUREMENTS ON SOLIDS. C. A. Swenson (Ames Lab., Ames, Iowa). [Feb. 5, 1962]. Contract [W-7405-eng-82]. 21p.

The results of recent measurements on the equations of state of Na and Xe are discussed. The experimental data for each of these are analyzed to show that the isothermal compressibility is solely a function of volume within experimental accuracy. The basic differences between the low temperature P-V relationships for Na and Xe are shown to be easily understandable in terms of the elementary theories of these substances. The range of experimental pressures (to 20 kbars) and temperatures (20°K to the triple point) is sufficiently great so as to produce significant changes in the lattice thermal properties in each case. These changes are indicated through the use of zero pressure heat capacity data in combination with the equation of state data to calculate the volume and temperature dependence of the Debye θ. The result is quite spectacular for Xe, where a pressure of 20 kbars roughly doubles θ_D. (auth)

22269 (JINR-P-1215) THERMODINAMICHESKIE FUNKTSII GRINA IZOTROPNOGO ANTIFERROMAGNETIKA S PROIZVOLNYM SPINOM. (Thermodynamical Green's Functions of Isotopic Antiferromagnetic with an Arbitrary Spin). E. Chervonko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 12p.

Equations were considered for the Green functions of an isotropic antiferromagnetic with an arbitrary spin in the presence of the longitudinal and perpendicular external magnetic field. In the superpositional approximation these equations lead to a system of equations for the one-particle averages. They were obtained in a concrete form for spin less than 3. All the equations obtained are valid at low and high temperatures and can be used for ferromagnetic in the form indicated in the paper. Equations for the magnetization are obtained by eliminating all the remaining averages. These equations are then solved at low temperature and near the Curie point, in the latter case this also holds for ferromagnetics. (auth)

22270 (LADC-5771) A THEORETICAL AND "EXPERIMENTAL" INVESTIGATION OF ONE-DIMENSIONAL MOLECULAR DISTRIBUTION FUNCTIONS. Samuel Blackman (Los Alamos Scientific Lab., N. Mex.). 1963. Contract [W-7405-eng-36]. 66p.

Thesis submitted to Univ. of New Mexico, Albuquerque.

The presence of long range forces and of various types of boundary conditions may be expected to cause deviations from the well known Maxwell-Boltzmann velocity distribution, resulting in a spatially dependent velocity distribution. A theoretical spatially dependent velocity distribution is obtained by an approximate solution for Liouville's equation. The effects of a long range repulsive force inversely proportional to the interparticle separation as well as the effects of three types of wall boundary conditions upon the velocity distributions of a one-dimensional set of ordered particles were also investigated experimentally. "Experimental" results were obtained from a computer program that was written in order to follow the dynamics of this one-dimensional set of ordered particles. The results are compared with the approximate solution of Liouville's equation for three types of wall boundary condition: specular, thermal, and a particular case of non-thermal wall. For thermal boundary conditions the use of different temperatures for the walls lead to an energy transfer, and thus it was possible to study certain aspects of heat flow. In this case an approximate solution of Liouville's equation is noted to lead to a spatially dependent velocity distribution that gives agreement with ex-

periment. Also the wall boundary conditions are found to be more influential in causing deviations from a Maxwell-Boltzmann distribution than is the particular long range force used. The feasibility of possible further applications of computer methods to study problems in the field of kinetic theory is suggested. (auth)

22271 (MMPP-NPC-1-4) LATTICE WAVES, SPIN WAVES, AND NEUTRON SCATTERING. B. N. Brockhouse (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). [1961]. For Univ. of Michigan, Michigan Memorial-Phoenix Project, Ann Arbor. 51p.

Use of neutron inelastic scattering to study the forces between atoms in solids is treated. One-phonon processes and lattice vibrations are discussed, and experiments that verified the existence of the quantum of lattice vibrations, the phonon, are reviewed. Dispersion curves, phonon frequencies and absorption, and models for dispersion calculations are discussed. Experiments on the crystal dynamics of metals are examined. Dispersion curves are presented and analyzed; theory of lattice dynamics is considered; effects of Fermi surfaces on dispersion curves; electron-phonon interactions; electronic structure influence on lattice vibrations, and phonon lifetimes are explored. The dispersion relation of spin waves in crystals and experiments in which dispersion curves for spin waves in Co–Fe alloy and magnons in magnetite were obtained and the reality of the magnon was demonstrated are discussed. (D.C.W.)

22272 (MND-2945-2) NUCLEAR FUEL (OXIDE) CLAD THERMIONIC CONVERTERS. Quarterly Technical Progress Report for the Period, February 1 through April 30, 1963. (Martin-Marietta Corp. Aerospace Div., Baltimore). May 15, 1963. Contract AF33(657)-10077. 40p.

A revised intermodule lead configuration was incorporated into the double-diode thermionic converter to reduce the extent of back-emission observed in operation of earlier double-diode devices. Completion of fueled emitter component fabrication is reported along with information concerning fabrication and pre-test examination of fuel pellets to be subjected to thermal endurance tests. A vacuum emission test using fuel pellets similar to the fueled emitters was conducted. (J.R.D.)

22273 (MND-P-2835) SNAP 7D—STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR POWER SOURCE. THIRTY-WATT U. S. NAVY FLOATING WEATHER STATION. Final Report. C. N. Young (Martin-Marietta Corp. Aerospace Div., Baltimore). Mar. 15, 1963. Contract AT(30-3)-217. 102p.

The objectives of the SNAP-7D program were to design, manufacture, test and deliver a thirty-watt electric generating system for a modified U. S. Navy NOMAD-class weather buoy to be stationed in the Gulf of Mexico. The sixty-watt Sr^{90} thermoelectric generator, the relay panel, the batteries, and the installation of the system in a boat-type buoy are described. In addition to delivering the power supply, many tests were required for the SNAP-7D system to demonstrate its conformance to the contract statement of work. The electrical tests of the generator and of the system, the shock and vibration tests, and the tests at the environmental temperature extremes are discussed. (auth)

22274 (NP-12721) STREUUNG VON 25 kev-ELEKTRONEN AN HELIUM, NEON, ARGON, KRYPTON UND XENON. (Scattering of 25 kev Electrons on Helium, Neon, Argon, Krypton, and Xenon (thesis)). Juergen Geiger (Berlin. Technische Universität). 1962. 47p.

Quantitative studies were made of the angular distribution of elastic and inelastic scattering of 25-kev electrons on noble gases, and the results were compared with scattering theory in the Born approximation. Results are presented in tables and graphs. (M.C.G.)

22275 (NP-12725) ÜBER DEN EINFLUSS VON HAFTSTELLEN AUF DEN LUMINESZENZMECHANISMUS. (On the Influence of Confinement on the Luminescence Mechanism (thesis)). Kurt Lertes (Berlin. Technische Universität). 1961. 82p.

The physical nature of confinement and its relation to the luminescence mechanism was studied. The investigations were carried out with uv, x, and cathode rays. For the measurement of short-time decay processes equipment with high resolving power was prepared. Results of investigations of cathode thermoluminescence, the luminescence of tungstates and molybdates, and the thermoluminescence of zinc oxide are presented. (M.C.G.)

22276 (NYO-9459) THERMAL CONDUCTANCE OF METALLIC SURFACES IN CONTACT. John Jewett Henry (Massachusetts Inst. of Tech., Cambridge. Heat Transfer Lab.). Feb. 1963. Contract AT(30-1)-2079. 71p.

Research in thermal contact resistance at MIT and advances made during the past year are summarized. The problem of predicting contact resistance is examined in an analysis of a model for the contact which relates the geometry of actual surfaces in contact to the contact model, and a deformation analysis which relates the contact geometry to the load carried by the surfaces. Experimental procedures are described and are applied to two stainless steel surfaces in contact and to W and graphite surfaces in contact. A significant result is that a surface may be described by two measurable parameters which may be combined with two such parameters of any other surface to completely determine the geometry of the interface if they are placed in contact. It thus remains to construct a device which will readily measure these two parameters. (auth)

22277 (TID-18323) RADIOISOTOPE-FUELED POWER SUPPLIES. Lecture Presented at University of California, Los Angeles, California, UCLA Short Course, Space Power Systems, July 17-28, 1961. J. G. Morse (Martin Co., Baltimore). 133p. Contract AT(30-3)-217. 133p.

Considerations that permit selection of a radioisotope that meets the complex requirements of the desired power supply are discussed. Methods of separation and purification of useful isotopes are outlined. Brief mention is made of the principles of direct conversion of heat to electricity. Design approaches for isotopic power units are described. A delineation of the approach to the solution of the nuclear safety problem is made, followed by predictions for the future of isotopic power. Sample problems of the type solved in the SNAP program are given. (M.C.G.)

22278 (TID-18543) [MOLECULAR QUANTUM MECHANICS]. Final Technical Progress Report, July 1, 1954–March 31, 1963. Joseph O. Hirschfelder (Wisconsin. Univ., Madison). Contract AT(11-1)-298. 12p.

Research on molecular quantum mechanics during the ten year contract period is briefly summarized. References are given to more complete reports of the work. (D.C.W.)

22279 (TID-18571) STRETCH SIN—A CODE FOR COMPUTING ONE-DIMENSIONAL REACTIVE HYDRODYNAMIC PROBLEMS. Charles L. Mader (Los Alamos Scientific Lab., N. Mex.). Apr. 1, 1963. Contract [W-7405-eng-36]. 31p. (GMX-2-R-63-1)

A code for the IBM 7030 computer for computing one-dimensional reactive hydrodynamic problems in slab, cylindrical or spherical geometry using realistic equations of state is described. (auth)

22280 (USNRDL-TR-610) ON LATENT IMAGE FADING IN ILFORD K.0 AND K.2 EMULSIONS. E. V. Benton (Naval Radiological Defense Lab., San Francisco). Jan. 4, 1963. 23p. (AD-402836)

Fading in Ilford K.0 and K.2 emulsions was investigated at +20 and −20°C. Track segments with rates of energy loss from 0.6 to 1.8 Mev/micron were used. K.0 and K.2 emulsions stored for 30 days at −20°C showed no evidence of fading. After a 30-day fading period, K.2 emulsion stored at +20°C and at 50% relative humidity showed less than 10% fading. K.0 emulsion stored at +20°C and at 50% relative humidity showed severe fading. This is illustrated by curves of grain density vs residual range for 2-, 6-, 13-, and 30-day fading periods. (auth)

22281 (USNRDL-TR-623) HYDRA PROGRAM. THE NRDL LOW-YIELD UNDERWATER EXPLOSION TANK AND ASSOCIATED INSTRUMENTATION. R. R. Buntzen (Naval Radiological Defense Lab., San Francisco). Feb. 18, 1963. 25p.

A facility was designed and constructed to simulate underwater nuclear explosions on a very small scale by employing a submerged exploding wire in a contained environment. This facility is a laboratory complement to the NRDL HYDRA Program. The variable-pressure explosion tank and related mechanical features are described. Development of the energy storage system, trigger, and discharge circuit for the submerged exploding wire are discussed. The instrumentation needed to determine the explosion yield and the results for a 25-kv discharge are given. (auth)

22282 (JPRS-18823) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION. Translation of Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika, 5: No. 5, 839-1044(Sept.-Oct. 1962). 496p. (OTS-63-21632)

Twenty-nine articles on ionospheric and space research, plasma phenomena and equipment, charged particle motion in fields and plasmas, certain specialized electrical circuits, and electromagnetic radiation are included. Abstracts were prepared for eight of the articles. (D.C.W.)

22283 (JPRS-18823(p.1-72)) INVESTIGATION OF ELECTRON DENSITY IRREGULARITIES IN THE IONOSPHERE BY RADIOASTRONOMICAL METHODS AND WITH SATELLITES. L. M. Erukhimov (Yerukhimov). Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 839-65(Sept.-Oct. 1962).

Methods for investigating the ionospheric irregularities that produce fluctuations in the cosmic radio emission and satellite signals are discussed, and analysis of diffraction patterns obtained in these investigations is considered. Information on the daily and seasonal variation of fluctuations; on the connection between fluctuations and ionospheric parameters; on the dimension, form, and height of irregularities; on drifts of ionospheric irregularities; on the connection between fluctuations and variations in the earth's magnetic field; and on large-scale irregularities in the ionosphere is reviewed. 133 references. (D.C.W.)

22284 (JPRS-18823(p.73-91)) METHODS FOR MEASURING SPATIAL VARIATIONS OF THE SPECTRUM OF COSMIC RADIO EMISSION. G. G. Getmantsev and V. A. Razin. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 866-72(Sept.-Oct. 1962).

Methods are discussed for increasing the accuracy of measurement of the spatial variations of the spectroindex of cosmic radio emission. (auth)

22285 (JPRS-18823(p.151-8)) RADIATION FROM A CHARGE MOVING IN AN INHOMOGENEOUS MEDIUM. V. Ya. Eidman (Eydman). Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 897-900(Sept.-Oct. 1962).

An expression is derived for the energy radiated when a charge moves in a stratified-inhomogeneous medium at an angle to the direction in which the properties of the medium change. (auth)

22286 (JPRS-18823(p.159-74)) PROPAGATION OF PLANE ELECTROMAGNETIC WAVES IN PERIODICALLY NONSTATIONARY MAGNETOACTIVE PLASMA. V. N. Lugovoi (Lugovoy). Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 901-7(Sept.-Oct. 1962).

The propagation of plane electromagnetic waves in a rarefied plasma situated in a homogeneous alternating magnetic field $H_1(t) = H_0[1 - X\cos(pt)]$ is considered. The absorbent properties of such a medium are determined for different types of electromagnetic waves in the medium, as functions of the amplitude of the alternating component of the magnetic field X. (auth)

22287 (JPRS-18823(p.234-62)) LOW-FREQUENCY BOUNDARY OF THE HIGH-FREQUENCY QUASI POTENTIAL IN A POSITIVE-COLUMN PLASMA. K. S. Golovanivskii (Golovanivskiy) and A. A. Kuzovnikov. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 933-44(Sept.-Oct. 1962).

The frequency characteristics of the effective limitation of radial diffusion of ions of a positive-column plasma by an inhomogeneous high-frequency field are investigated in the region of low radio frequencies. A variation was observed in the radial diffusion current in the field of high-frequency average potential, and a dependence of the limiting frequency of the investigated effect on the density of the plasma ions was noted. The last result is interpreted from the point of view of the dynamics of the polarization of a plasma in an external electric field. (auth)

22288 (JPRS-18823(p.290-303)) EXPERIMENTAL INVESTIGATION OF METHODS FOR THE FORMATION OF TROCHOIDAL ELECTRON BEAMS BY PHOTOGRAPHY OF ELECTRON TRAJECTORIES. V. A. Flyagin and T. B. Pankratova. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 956-62(Sept.-Oct. 1962).

Results are presented of an experimental investigation of electron guns with "short" and "long" optical systems, which form in crossed electric and magnetic fields trochoidal electron beams with large values of the parameter $f = v_\perp/v_\parallel \sim 10 - 20$. To study the electron-optical systems, a method involving observation of the electron trajectories in an imperfect vacuum (at a pressure 5×10^{-4} to 5×10^{-5} mm Hg) was used. The results of the experiments are in sufficiently good agreement with the theoretical representations. (auth)

22289 (JPRS-18823(p.304-21)) CONCERNING THE DETECTOR PROPERTIES OF A PLASMA. G. A. Sobol'. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 963-71(Sept.-Oct. 1962).

A simplified method is developed for the determination of the parameters of the plasma with the aid of detector characteristics, based on the experimental formulas for the probe and detector currents. An experimental confirmation of these formulas is given. The method of de-

tector characteristics is used to analyze the previously obtained experimental data, as a result of which the dependence of the detector current on the electric mode of the discharge, on the gas pressure in the tubes, on the gas ionization intensity, and on the radius of the discharge tube is obtained. (auth)

22290 (JPRS-18823(p.322-35)) INVESTIGATION OF CERTAIN PROPERTIES OF A DELAY SYSTEM CONSISTING OF A PLASMA ROD SURROUNDED BY A HELIX. S. M. Levitskii (Levitskiy) and N. S. Baranchuk. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 972-7(Sept.-Oct. 1962).

Calculations were made of the phase velocity and the wave impedance in a delay system consisting of a plasma rod, surrounded by a helix; the results of the calculation are compared with the experimental data. It is shown that at small plasma densities the properties of the system approach the properties of the helix, while at large densities they approach the properties of a plasma waveguide. (auth)

22291 (NP-tr-1000) ANGULAR CORRELATION MEASUREMENTS IN SUPERCONDUCTING MEDIA. H. Albers-Schoenberg and E. Heer. Translated by W. D. Newman (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Helv. Phys. Acta, 28: 389-94(1955). 9p.

The angular correlations of two successive nuclear radiations following the K-capture of In^{111} was measured in metallic In sources above and below the superconducting transition temperature. Within the accuracy of the experiment, no change in the correlation was found, indicating that the electron distribution in the normal and superconducting states is approximately the same. (auth)

22292 (SCL-T-475) A CHARACTERISTICS METHOD FOR 3-D UNSTEADY GAS FLOWS. Gerhard Bruhn and Wolfgand Haack. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Z. Zngew. Math. Phys., 9b: No. 12, 173-90(1958). 30p.

A general three-dimensional characteristic method for the inviscid flow of ideal gases is derived using some simple facts from the differential geometry of vector fields. The fundamentals of a general numerical method are deduced from the system of the characteristic equations. They are applied to a special case of two-dimensional flow. (auth)

22293 A FURTHER APPLICATION OF THE METHOD OF SPIN OPERATORS. F. Berencz (Univ. of Szeged). Acta Phys. Acad. Sci. Hung., 15: 351-2(1963). (In English)

The method of spin operators is applied to the determination of the eigenfunctions of atomic states. (C.E.S.)

22294 TRANSMISSION OF 100-472 kev MONOENERGETIC ELECTRONS THROUGH Al ABSORBERS. D. Berényi and M. Osvay (Inst. for Nuclear Research, Hungarian Academy of Sciences, Debrecen). Acta Phys. Acad. Sci. Hung., 15: 357-9(1963). (In English)

Electron absorption curves were presented for 100, 150, 200, 219, 252, 281, 308, 334, 391, 417, 445, and 472 kev monoenergetic electrons in aluminum. The limit of error for the energy value in the measurements was about ±2 kev at the higher energies, decreasing to about half that amount at the lowest energies. (C.E.S.)

22295 THE STRUCTURE OF ISOCHROMATIC BREMSSTRAHLUNG OF SILICON AND GERMANIUM. Julian Auleytner and Bo Lidén (Uppsala Univ.). Arkiv Fysik, 23: 41-8(1963). (In German)

The structure of the short-wave edge of the bremsstrahlung spectrum was investigated for vapor-deposited films and single crystals of Si and Ge by using the isochromatic method. The apparatus used was described by Johansson in Arkiv for Fysik 18, 291 and 329(1960). The reference wave length was 2285 X units (Cr $K\alpha_1$). It was shown that the energy difference of the isochromatic step from the leading edge of the isochromate agrees well with the corresponding electron energy loss. The difference measured can be explained quantitatively using the Hayasi theory of quasi-stationary states. (tr-auth)

22296 ON THE SWARM METHOD FOR DETERMINING THE RATIO OF ELECTRON DRIFT VELOCITY TO DIFFUSION COEFFICIENT. R. W. Crompton and R. L. Jory (Australian National Univ., Canberra). Australian J. Phys., 15: 451-69(Dec. 1962).

The use of data from swarm experiments for electron energies approaching those corresponding to thermal equilibrium demands results of greater precision than was hitherto available. In order to examine the possibility of producing such data, the swarm method for determining W/D was extensively examined over a range of values of the parameter E/p where the agreement between the results of recent investigations is not good. A number of factors influencing the accuracy of measurements of this type are discussed. The results for hydrogen that are presented are considered to be subject to an error of less than 1%. (auth)

22297 CALCULATION OF THE DOSE RATE INSIDE A SPHERICAL SOURCE WITH A GAUSSIAN DISTRIBUTION OF THE γ-EMITTER. Yu. A. Izrael. At. Energ. (USSR), 14: 317-18(Mar. 1963). (In Russian)

The solution of certain geophysical problems requires the calculation of the γ-dose rate in air within a spherical source with a symmetrical distribution of the emitter with respect to the center. The concentration of the emitter is expressed in energy units, e.g., in Mev/cm^3 sec. Such calculations were carried out for an air-equivalent absorbing medium. The calculations yielded a simplified formula which may be used within the energy range from 0.5 to 2.0 Mev. The conditions, under which the error is kept below 25%, were established; for other conditions, a correction factor must be used. (TTT)

22298 LARGE-SCALE MAGNETOHYDRODYNAMIC POWER GENERATION. D. T. Swift-Hook (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Brit. J. Appl. Phys., 14: 69-76(Feb. 1963).

The basic physical principles of magnetohydrodynamic generation are described, and the electrodynamics and thermodynamics are discussed. The interaction is controlled by the plasma conductivity, which is low, and methods of increasing it are mentioned. The quasi-one-dimensional flow equations are presented, and methods of solution are outlined. The practical problems are discussed, and a survey is made of experimental work to date. The immediate prospects for open-cycle fossil-fuel devices give grounds for cautious optimism, and possible future developments include superconducting electromagnets, closed cycles for nuclear applications, and a-c generation. (auth)

22299 ON THE MEASUREMENT OF CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN METAL FILMS. O. Klemperer and J. P. G. Shepherd (London Univ.). Brit. J. Appl. Phys., 14: 85-8(Feb. 1963).

The design and construction of a high-resolution electron spectrometer in which electrons are transmitted through thin films are described. It utilizes a retarding field with subsequent deflection of the electrons by a cylindrical magnetic prism. Tests for, and corrections and precautions

against, possible errors are given with details of the results of the measurements of the spectra of Al and Cu. (auth)

22300 CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN ALLOYS. O. Klemperer and J. P. G. Shepherd (London Univ.). Brit. J. Appl. Phys., 14: 89-94(Feb. 1963).

Characteristic energy losses of electrons in the alloys Mg–Al and of Al–Cu were investigated. Electrons of about 10 kev were transmitted through thin films of the alloys. The energy spectra of the transmitted electrons were registered with a spectrometer of high resolving power. The measurements of the losses in Al–Cu alloys were correlated with the composition of the alloy films determined by chemical microanalysis. It was shown that the spectra of the alloys cannot be explained by the assumption of a simple superposition or combination of the spectra of the component metals. The suggestion is put forward that the spectra of the alloys are a superposition of the spectra corresponding to various phases of the alloy. This suggestion was checked in detail for a whole range of Al–Cu alloys. In the case of Mg–Al alloys, no definite conclusions could be drawn from the experimental results owing to the strong oxidation of the thin films of this alloy. (auth)

22301 THE EMISSION SPECTRA OF ORGANIC LIQUID SCINTILLATORS. J. B. Birks, J. E. Geake, and M. D. Lumb (Univ. of Manchester, Eng.). Brit. J. Appl. Phys., 14: 141-3(Mar. 1963).

The fluorescence emission spectra of toluene solutions of seven efficient scintillator solutes (TP, QP, TPB, DPH, DPA, PPO, and POPOP) were measured with a recording photoelectric spectrophotometer at a resolution of about 8 Å. The fluorescence was excited mainly by 2537 Å radiation from a low pressure mercury lamp with filters. Self-absorption effects were studied using different solution depths and concentrations. (auth)

22302 ION BOMBARDMENT INDUCED RE-EMISSION STUDIES OF ARGON IN AN IONIZATION PUMP. L. H. James and G. Carter (Univ. of Liverpool). Brit. J. Appl. Phys., 14: 147-54(Mar. 1963).

The re-emission of ionically pumped argon in a glass diode ion pump, when bombarded with the other inert gases He, Ne, Kr, and Xe, was studied. It was found that the removal efficiency increases to an apparent saturation with increasing bombarding ion energy, but even at the highest bombarding energy used (1 kev) it was never possible to recover completely all sorbed primary gas. This and other evidence leads to the conclusion that argon is released from the glass by transfer of sufficient energy by a bombarding ion, via the glass atoms, to the sorbed argon: sputtering of the glass with simultaneous argon release appears to be unimportant. The effective gas sputtering coefficients for argon releasing argon and the maximum possible surface coverage are deduced. (auth)

22303 SHORT FORMATIVE TIME LAGS (3-100 nsec) IN HYDROGEN AT LOW PRESSURES (5-50 mmHg). G. A. Dawson and D. E. Davies (Univ. of Keele, Staffordshire, Eng.). Brit. J. Appl. Phys., 14: 155-6(Mar. 1963).

Measurement of the rapid growth of current in an overvolted gap was used to determine formative time lags. Curves of formative time lag against percentage overvoltage are presented, and a method of determining electron drift velocities is discussed. (auth)

22304 THERMAL AND PHOTOELECTRIC IONIZATION OF SOLID PARTICLES. M. S. Sodha (Republic Aviation Corp., Farmingdale, N. Y.). Brit. J. Appl. Phys., 14: 172-6(Apr. 1963).

A discussion of the various physical processes relevant to the ionization of solid particles is given. Detailed considerations of the rates of thermionic and photoelectric emission from charged particles, electron attachment and recombination with charged particles and energy exchange in these processes are presented. From these considerations an expression for the equilibrium constant of the ionization reaction of solid particles was derived. The steady state and transient charge distribution and energy exchange under non-equilibrium conditions were also investigated. Expressions for refractive index and absorption coefficient of the medium for electromagnetic waves were also derived. (auth)

22305 FACTORS AFFECTING THE THRESHOLD FOR LASER ACTION IN CaF_2 CRYSTALS DOPED WITH URANIUM AND OTHER HOST LATTICES. D. W. Goodwin (Royal Radar Establishment, Great Malvern, Worcs, Eng.). Brit. J. Appl. Phys., 14: 223-4(Apr. 1963).

Measurements of the scattering extinction coefficient as a function of wavelength were carried out on uranium-doped calcium fluoride single crystals. An analysis of these measurements indicates that the scattering centers have diameters in the range 0.7 to 1.5 μm and a refractive index close to 1.8, indicative of calcium oxide as a secondary phase. From microscopic investigations estimates of the range of both particle size and density were obtained, and it was also found that the refractive index of the scattering particles was greater than that of the host material. The refractive index of the centers was deduced from appropriate scattering extinction curves. From a prior knowledge of refractive index the scattering extinction coefficient offers an average value of both particle size and diameter. Other host crystals were $CaWO_4$, SrF_2, BaF_2, and PhF_2. (C.E.S.)

22306 THE DERIVATION OF APPROXIMATE X-RAY SPECTRAL DISTRIBUTIONS AND AN ANALYSIS OF X-RAY "QUALITY" SPECIFICATIONS. J. R. Greening (Royal Infirmary, Edinburgh). Brit. J. Radiol., 36: 363-71 (May 1963).

Methods of deriving and specifying approximate methods of x-ray spectral distribution if either the time or facilities are not available for obtaining complete spectra are discussed and compared. Tables are provided that simplify the representation of an x-ray beam by three monoenergetic components when the transmission curve of the radiation in a suitable absorber is known. In another approach three components are fitted graphically to the attenuation data. The amount of information regarding an x-ray spectrum, which can be derived from the various forms in which radiation quality may be expressed, is also considered. The specifications examined are: HVT only; HVT and kilovoltage; first and second HVT; first and second HVT and kilovoltage; and full attenuation curve and kilovoltage. From these are derived representations by means of 1, 2, or 3 monoenergetic components and by approximate or accurate spectral distributions. (P.C.H.)

22307 THE INFRARED ABSORPTION OF SOME CRYSTALLINE INORGANIC FORMATES. K. B. Harvey, B. A. Morrow, and H. F. Shurvell (Univ. of British Columbia, Vancouver). Can. J. Chem., 41: 1181-7(May 1963).

The infrared absorption of some polycrystalline alkali metal and alkaline earth formates was measured in the region of 500 cm^1 to 3000 cm^{-1}. The observed crystal splitting of the formate fundamentals is discussed in terms of a vibrational analysis under the factor group. (auth)

22308 AECL'S PHASED ROTOR NEUTRON SPECTROMETER. I. M. Thorson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Nucl. Tech., 2: No. 2, 46-9 (1963).

Neutron scattering experiments in solids and liquids are considered briefly, and a phased-rotor spectrometer and its operation in such experiments are described in some detail. Illustrative results are given for neutron scattering in H_2O and UO_2 at 25°C. (D.L.C.)

22309 THE STRUCTURE OF A MAGNETIC TOROIDAL FIELD WHICH POSSESSES NO MAGNETIC SURFACES. I. M. Gel'fand, M. I. Graev, N. M. Zueva, M. S. Mikhaĭlova, and A. I. Morozov. Dokl. Akad. Nauk SSSR, 148: 1286-9 (Feb. 21, 1963). (In Russian)

The authors have shown previously (Zhur. Tekh. Fiz., 31: No. 10(1961)) that the magnetic surfaces are disrupted in the case of the "resonance" disturbance of a 3-turn screw-type magnetic field by a crimped field with a sufficiently high amplitude. Numerical calculations were carried out for determining the value of the lines of force under the specified conditions. The results shed some light on the behavior of a field with disruptive magnetic surfaces, defining the magnetic surface as a close toroidal surface around which a line of force is wound. The stability conditions of the unstable field indicated the existence of two sets of surfaces possessing the property of converting into each other in one period of the field. (TTT)

22310 AUTORADIOGRAPHY OF WOOD SPECIMENS FROM THE REGION AFFECTED BY THE FALL OF THE TUNGUS METEORITE. Yu. M. Emel'yanov and V. I. Nekrasov (Moscow State Univ. and Main Botanical Garden, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 148: 1418-21(Feb. 21, 1963). (In Russian)

Samples taken from trees growing in the impact area of the 1908 Tungus meteorite were subjected to autoradiographic analysis in order to confirm or disprove statements made in several publications since 1959 that the radioactivity of the vegetation of the area continues to increase. The samples, obtained from the material brought back by the 1958 and 1960 expeditions of the Academy and its Siberian Branch, were dried, polished, and placed on Agfa x-ray film for 7 months. Examination of the autoradiograms revealed no increase of the radioactivity of the pine, spruce, and larch specimens since 1908; to the contrary, a certain decrease was noted in the spruce samples. During the past few years the activity seems to increase but this is attributed to fallout. (TTT)

22311 JUNCTION FORMATION IN SILICON BY POSITIVE ION BOMBARDMENT. R. R. Ferber (Westinghouse Electric Corp., Pittsburgh). IEEE (Inst. Elec. Electron. Engrs.) Trans. Nucl. Sci., NS-10: No. 2, 15-20(Apr. 1963).

The effects of silicon bombardment by hydrogen, nitrogen, oxygen, neon, xenon, phosphorus, and boron ions were studied using a Van de Graaff accelerator and a 250 kv Cockroft-Walton accelerator to produce ions with energies ranging from 50 kev to 1 Mev. Bombardments with each of the gaseous ions produced type conversion in p type silicon. The n type layers formed all have rather high resistivities (1 ohm or greater) with very weak n type conductivity characteristics. These junctions were apparently produced by radiation damage induced donor sites and might more appropriately be called p-i junctions. Only the phosphorus and boron bombardments showed evidence of impurity or chemical doping effects. Post bombardment annealing was done on the various bombarded cells with rather striking improvement in characteristics occurring in the case of the boron bombarded n type silicon blanks. It is felt that, with further effort, this technique may be quite applicable to molecular electronics and other types of semiconductor device preparation using programmed phosphorus and boron ion bombardment. (auth)

22312 RESONANCE IN ELECTRON CAPTURE BY PROTON PASSING THROUGH HYDROGEN ATOMS. S. C. Mukherjee and N. C. Sil (Indian Assn. for the Cultivation of Science, Calcutta). Indian J. Phys., 36: 622-9(Dec. 1962).

Recent experimental results on the capture probability of an electron by a proton passing through hydrogen atom shows that at a scattering angle of 3°, the capture probability when plotted against the reciprocal of the proton velocity reveals resonant structure with maxima and minima. It is found that the application of the variational method of Sil, in the low energy region reproduces this structure fairly well. The theoretical results begin to differ from the experimental findings at 3 kev, and thereafter the difference goes on increasing with higher energies. The proton-proton interaction was neglected. (auth)

22313 STABILITY OF PLAIN LAYER OF IDEALLY CONDUCTING VISCOUS FLUID IN LONGITUDINAL MAGNETIC FIELD. G. A. Glanti (Tagan-Rog Pedagogical Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 6, 169-70(1962). (In Russian)

It is shown that ideally conducting viscous fluid is unstable in a longitudinal magnetic field. (R.V.J.)

22314 ELECTRON 'TEMPERATURE' IN CROSSED FIELDS. P. A. Lindsay (Raytheon Co., Burlington, Mass.) and G. D. Sims. J. Electron. Control (1), 14: 273-88(Mar. 1963).

Lately a general steady-state theory of continuous-cathode crossed-field devices was developed, by taking into account the initial velocity distribution of the emitted electrons. A study is made (1) to see how far this theory can account for the shape of the cut-off curve of a magnetron, (2) to investigate some general and important consequences of the initial velocity spread of the emitted electrons, and (3) to explain the existence of high "temperature" in systems which conserve energy rigorously. A graphical solution of the transcendental equation for calculating the idealized cut-off or Hull radius of cylindrical magnetrons is added. (auth)

22315 THE ROTATION OF EIGENVECTORS BY A PERTURBATION. Chandler Davis (New York Univ., New York). J. Math. Anal. Appl., 6: 159-73(Apr. 1963).

Although the behavior of the eigenvalues of a hermitian matrix under perturbation is fairly well understood, there has been almost nothing done on the behavior of the eigenvectors. It is well known that they vary analytically under analytic perturbations but for some purposes one would prefer sharp bounds on the distance between the eigenvectors of a matrix and those of a matrix approximating it. Two sets of theorems of this sort are given. (auth)

22316 EXPLICIT PERTURBATION FORMULAS AND CONVERGENCE THEOREMS. F. H. Brownell (Univ. of Washington, Seattle). J. Math. Anal. Appl., 6: 190-206 (Apr. 1963).

Explicit formulas for the eigenvalue and eigenvector series covering all possible splitting cases are presented. These formulas avoid the restrictions placed on the Banach or Hilbert space linear operator. By the use of majorants, convergence of these series is proved and error estimates under suitable boundedness assumptions are given for a few special splitting cases. These arguments appear to carry over to any given splitting case. An example of a nonisolated space linear operator is given for which the boundedness and other assumptions hold. (C.E.S.)

22317 MECHANICAL MODEL FOR QUANTUM FIELD THEORY. Asher Peres (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 4: 332-3(Mar. 1963).

Two harmonic oscillators, coupled during a finite time

are considered. Initial and final states can be defined unambiguously, and if the duration of the coupling is sufficiently short, the S matrix can be computed explicitly. The coupling gx^2y is investigated in detail, for complex values of g. It is found that, along the real axis, the S matrix behaves smoothly as a function of g and tends to the unit matrix for $g \to 0$, as it should. However, the S matrix has a line of essential singularities along the imaginary g axis, including the origin, so that it cannot be expanded into powers of g. If such an expansion is sought by means of a perturbation procedure, it is found that each term of the series is finite, but the series as a whole diverges. (auth)

22318 ON THE NONORTHOGONALITY OF GENERALIZED MOMENTUM EIGENFUNCTIONS IN QUANTUM MECHANICS. Peter D. Robinson (Univ. of Wisconsin, Madison). J. Math. Phys. (N. Y.), 4: 348-53(Mar. 1963).

The orthogonality requirement usually specified for the eigenfunctions ϕ of a quantum-mechanical operator P that has a continuous spectrum of eigenvalues λ, is $\int \phi^*(\lambda)\phi(\lambda')\, d\lambda = \delta(\lambda - \lambda')$. The derivation of this result is examined; it is seen to be merely a sufficient, but not a necessary condition for the consistent expansion of a bound-state wavefunction Ψ in the form $\int \alpha(\lambda)\phi(\lambda)\, d\lambda$. The situation in which P is a generalized momentum operator is investigated in detail. It is shown that any two of the corresponding momentum eigenfunctions are not usually orthogonal. Nevertheless, with the help of Fourier analysis, a consistent expansion $\Psi = \int \alpha(\lambda)\phi(\lambda)\, d\lambda$ is established. The theory is illustrated with the familiar examples of a particle in a box and a ground-state hydrogen atom. When a space coordinate has a finite range, a quantum condition can be imposed on the generalized momentum eigenvalues so that the momentum eigenfunctions form a complete discrete orthogonal set. An attempt is made to justify the belief that such quantization is not essential unless it is necessary to ensure single-valued eigenfunctions. (auth)

22319 ELECTROSTATIC INTERACTIONS IN COMPLEX ELECTRON CONFIGURATIONS. B. G. Wybourne (Univ. of California, Berkeley). J. Math. Phys. (N. Y.), 4: 354-6 (Mar. 1963). (UCRL-10443)

Simplified expressions for the matrix elements of electrostatic interactions both within and between several types of complex electron configurations were obtained by the application of angular-momenta recoupling techniques. The use of these recoupling techniques avoids the usual extensive calculation of the sums of products of the matrix elements of tensors of the types $V^{\langle k}$ and U^k. The derived expressions involve the sums of products of coefficients of fractional parentage and n – j symbols, and as such, are amenable to machine computation. (auth)

22320 BINARY KERNEL FORMULATION OF A HEISENBERG MODEL OF FERROMAGNETISM. Newton I. Greenberg (Franklin Inst., Swarthmore, Penna.). J. Math. Phys. (N.Y.), 4: 405-9(Mar. 1963).

An ideal Heisenberg model of a ferromagnet for spin $\frac{1}{2}$ is studied by considering the model in terms of a spin-deviation lattice gas. Utilizing the general methods of Yang and Lee, a binary kernel function is obtained in terms of which the thermodynamic properties of the lattice gas can be completely expressed. As an example, Dyson's results are rigorously obtained. (auth)

22321 EQUIVALENCE AND ANTIEQUIVALENCE OF IRREDUCIBLE SETS OF OPERATORS. I. FINITE DIMENSIONAL SPACES. J. S. Lomont (Polytechnic Inst. of Brooklyn), H. E. Moses, and Kwang Yu. J. Math. Phys. (N. Y.), 4: 420-3(Mar. 1963).

Since an elementary dynamical system is specified by giving an irreducible set of dynamical variables, one is led to investigate the following problem: Given two irreducible sets of operators with a one-to-one correspondence between them, find the algebraic properties of the two sets that make it possible to infer the existence of a unitary or antiunitary operator relating them. A series of theorems is obtained from such considerations for finite dimensional spaces. It is shown that if the second set of operators contains some of the algebraic properties of the first set, the two sets are related by a similarity transformation. By altering the requirements, this transformation is a unitary transformation. Indications are also given to show how the theorems can be extended to Hilbert spaces. Finally, in the Appendix there is given a definition of invariance of elementary quantum-mechanical systems based on the above theorems, giving the same results as Wigner's definition in terms of transition probabilities. (auth)

22322 SYMMETRY FUNCTIONS OF THE CUBE. George T. Trammell (Oak Ridge National Lab., Tenn.). J. Math. Phys. (N. Y.), 4: 431-6(Mar. 1963).

A simple method is presented for reducing the 2 J + 1 state vectors of good total angular momentum J to cubic symmetry types (basic vectors of the irreducible representations of the cubic rotation group). The cubic symmetry functions are written explicitly in terms of the eigenfunctions of J_z, J_x, and J_y, and formulas and tables that facilitate their use in obtaining eigenfunctions and energy splittings of ions in fields of cubic symmetry are presented and applied. (auth)

22323 THE NEAR-INFRARED ABSORPTION SPECTRA OF SOME PENTAVALENT URANIUM FLUORIDES. THE $^2F_{5/2} \to {}^2F_{7/2}$ TRANSITION. Martin J. Reisfeld (Los Alamos, Scientific Lab., N. Mex.) and Glenn A. Crosby. J. Mol. Spectry., 10: 232-4(Mar. 1963). (LADC-5556)

Near-infrared absorption spectra were measured over the range 8,000 to 18,000 Å at 25°C for the following salts: NH_4UF_6, KUF_6, and $RbUF_6$. All the spectra are characterized by a single strong sharp band in the region of 14,200 Å and several weaker, diffuse bands at shorter wavelengths. The transition energies, spin-orbit coupling constants, and optical screening constants were calculated from the $^2F_{5/2} \to {}^2F_{7/2}$ transition of uranium(V) in these compounds. It is concluded that the strong band is due to the $^2F_{5/2} \to {}^2F_{7/2}$ transition. (D.L.C.)

22324 ROTATION–VIBRATION CONSTANTS OF ACETYLENE. Earle K. Plyler (National Bureau of Standards, Washington, D. C.), Eugene D. Tidwell, and T. A. Wiggins. J. Opt. Soc. Am., 53: 589-93(May 1963).

The study of the absorption spectrum previously reported was extended to include the 1900- to 2200- and the 4400- to 6750-cm^{-1} regions. Rotational analysis provides 20 states from which the following constants are determined: $\alpha_1 = 6.82$, $\alpha_2 = 6.30$, $\alpha_3 = 5.60$, $\alpha_4 = -1.30$, $\alpha_5 = -2.20 \times 10^{-3}$ cm^{-1} and $B_e = 1.18240$ cm^{-1}. This value was used with B_e values for C_2HD and C_2D_2 to determine the bond length of $r_e(C-H) = 1.0603$ and $r_e(C \equiv C) = 1.2034$ Å. A total of 46 states was available, from this and other work, to determine a set of vibrational constants. About one-half of the 23 constants were determined with acceptable precision. The remaining constants are still in doubt due, primarily, to resonances. (auth)

22325 ENERGY LEVELS OF Er II. Z. B. Goldschmidt (Hebrew Univ., Jerusalem). J. Opt. Soc. Am., 53: 594-5 (May 1963).

The eight known levels of Er II in the configuration

$4f^{12}6s$ are compared with the theoretical formulas. A very good agreement can be reached by choosing parameters whose ratios are somewhat different from those for a hydrogenic $4f$ eigenfunction. Discrepancies mentioned by Judd and Marquet are thereby eliminated. (auth)

22326 REFRACTIVE INDEX OF STRONTIUM MOLYBDATE SYNTHETIC SINGLE CRYSTAL. J. W. Lyle (Union Carbide Corp., Indianapolis). J. Opt. Soc. Am., 53: 637(May 1963).

The refractive index of the ordinary ray in $SrMoO_4$ single crystal was measured at 4047 to 7032 Å at 24°C. The index decreases from 1.904 at 4047 Å to 1.8290 at 7032Å. The data are compared with these reported in the literature for $SrMoO_4$ and $SrMoO_4$ – CeO mixed crystals. (D.L.C.)

22327 COMMENTS ON THE ARTICLE "PECULIARITIES OF THE ISOTOPE SHIFT IN THE SAMARIUM SPECTRUM." W. H. King (Clarendon Lab., Oxford). J. Opt. Soc. Am., 53: 638-9(May 1963).

Striganov et al. found large differences between the average relative shifts for the positive and negative isotope shifts in the samarium spectrum. They attributed the differences to varying influence of the deformed nucleus on the electron configuration. It is shown that this attribution is unnecessary and that the differences can be explained by considering the possible effect of specific mass shifts. A graphical method of studying the effect of mass shifts is described and applied to an analysis of the samarium results. (D.L.C.)

22328 A LOW ENERGY ION GUN FOR BOMBARDING SMALL SPECIMENS. P. Bowden and D. G. Brandon (Univ. of Cambridge, Eng.). J. Sci. Instr., 40: 213-15(May 1963).

A low-energy ion source for bombarding electron microscope specimens is described. The source is capable of delivering a current of 0.3 μa of 100 ev argon ions to an area 2.0 mm in diameter. (auth)

22329 THE PRACTICAL VALUE OF GAMMA SPECTRA. Zoltan Zsebok and Daniel Vodros. Magy. Radiol., 15: 34-42(Jan., 1963).

The spectrum of gamma-emitting radioactive isotopes is necessary for the evaluation of the character of radiation. The practical methods of recording are discussed. The elements of the scintillation spectrometer, the transformation of gamma quanta into electric impulses, that is, registrable signals, and the analysis of the gamma spectrum is presented. Identification of the emitting compound by this method is discussed and the resolution capabilities of the apparatus are demonstrated by an example. (auth)

22330 QUANTUM EFFECTS IN DILUTE SOLUTIONS. Ian H. Hillier and John Walkley (Imperial Coll. of Science and Tech., London). Nature, 198: 257-8(Apr. 20, 1963).

Examination of the saturation solubility properties of hydrogen and deuterium in a wide range of non-polar solvents and measurements of their partial molar volumes in a more restricted solvent range suggest that quantum effects are observed in the thermodynamic solubility properties of the two gases. Data pertinent to the investigations are tabulated. A measurable difference in properties of the two gases in a given solvent was found even at room temperatures. (C.H.)

22331 FORMAL SUM OF PAIRING DIAGRAMS. L. Blum (Facultad de Ciencias Exactas y Naturales, Buenos Aires). Nuovo Cimento (10), 28: 25-32(Apr. 1, 1963). (In English)

A method to summarize the connected diagrams of the master equation for the quantum fluids obtained elsewhere is used to obtain a compact expression of a set of diagrams called "pairing diagrams." An integral equation is obtained. The particular interest of the method is that the set of diagrams is the same that results from the effective hamiltonian of Bardeen, Cooper, and Schrieffer of superconductivity. Diagrams with repeated indices have to be excluded. (auth)

22332 T_{ab} AND T^*_{ba} AS OPPOSITE BOUNDARY VALUES. Muneer Ahmad Rashid and Ansaruddin Syed (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 28: 107-11(Apr. 1, 1963). (In English)

By use of generalized retarded operators, it is shown that the result that T_{ab} and T^*_{ba} are opposite boundary values of the same analytic function holds in axiomatic theory even for the processes $m \rightarrow n$. (auth)

22333 QUESTION OF THE VALIDITY OF NEWTON'S LAW AT COSMIC DISTANCES. A. Finzi (Università, Rome). Nuovo Cimento (10), 28: 224-6(Apr. 1, 1963). (In English)

Discrepancies in assumptions to explain the fact that in clusters of galaxies the kinetic energy is much greater than the potential energy, contrary to virial theorem predictions, lead to an assumption that the gravitational attraction at long distance is stronger than Newton's law predicts. Ability of the proposed force and potential relations to explain some previously inexplicable astrophysical observations is discussed. (D.C.W.)

22334 SEPARATION OF FISSION PRODUCTS OF VARIOUS MASSES IN A DOUBLE IONIZATION CHAMBER. Herbert Meister (Technische Hochschule, Munich). Nukleonik, 5: 3-8(Jan. 1963). (In German)

A new method for the rapid separation (about 10^{-2} sec) of fission products of various masses is reported. From the half of a double ionization chamber in which the fission occurs, and in which the particular ratio of the fission product masses was established by measurement of the electron currents of both fission products, the fission products selected were sucked off by pulsed electric fields as long as the fission products still possessed a residual ionization. The limits of this method with respect to mass resolution and intensity are given. (tr-auth)

22335 SCATTERING OF POSITRONS BY ATOMIC HYDROGEN. R. Ya. Damburg and E. M. Karule. Opt. Spectry. (USSR) (English Transl.), 14: 165(Feb. 1963).

Cross sections for elastic scattering from the ground state, excitation to the 2S state, and excitation to the 2p state were calculated for positrons incident on atomic hydrogen at momenta from K = 0.9 to 2.0. Partial cross sections for total orbital momentum equal to 0, 1, 2, 3, and 4; taking into account the strong coupling between the 1s, 2s, and 2p states; were obtained. (C.E.S.)

22336 FOCUSED COLLISION SEQUENCES IN TUNGSTEN AND MOLYBDENUM. R. S. Nelson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag., (8), 8: 693-705(Apr. 1963).

The resolution of momentum into focused collision sequences was studied in the bcc structure by observing the ejection of atoms from tungsten and molybdenum monocrystals undergoing irradiation with 50 kev Ar^+ ions. The ejected atoms were collected on glass plates, and by analizing the form of the deposits it was found that ejection occurred preferentially in the (111), (100), and (110) crystal directions. This is interpreted in terms of collision sequences traveling along these directions that, on intersecting the surface, cause ejection in the same direction. In order to obtain a qualitative understanding of the proc-

esses involved, some suggestions as to the possible focusing mechanisms are discussed, and approximate calculations of the relative focusing energies and ranges are shown to be consistent with the observed nature of the deposits. The appearance of faint streaks in the ejection patterns are explained in terms of the ejection of energetic recoil atoms whose trajectories are channeled between the {110} planes. (auth)

22337 THE THERMOELECTRIC POWER IN CHROMIUM AND VANADIUM. A. R. Mackintosh and L. Sill (Ames Lab., Ames, Iowa). Phys. Chem. Solids, 24: 501-6(Apr. 1963). (IS-573). (In English)

The thermoelectric power in pure chromium and vanadium was measured between 4.2 and 340°K and found to be positive in both metals over the whole temperature range. Maxima in the curves of thermopower against temperature at low temperatures are interpreted in terms of a phonon drag component. An anomaly in the results for both monocrystalline and polycrystalline chromium at the Néel temperature is interpreted in terms of the Lidiard-Overhauser model of conduction electron antiferromagnetism. Hysteresis in the measurements on chromium over the whole temperature range is attributed to the effect of antiferromagnetic domains. An anomaly in the thermopower of vanadium at approximately 217°K is attributed either to a transition to an antiferromagnetic state or to a structural phase transition, possibly involving ordering of impurities. Experiments for distinguishing between these possibilities are suggested. (auth)

22338 INVESTIGATION OF OPTICAL ABSORPTION IN IRRADIATED CsF. Floyd Hughes and Herbert Rabin (Naval Research Lab., Washington, D. C.). Phys. Chem. Solids, 24: 586-9(Apr. 1963). (In English)

Studies were made on the origin of the F band in the absorption spectra of alkali halides. CsF crystals were irradiated with x rays at 295°K and its absorption spectrum determined at 295, 80, and 18°K. The spectrum had a principal triplet (636, 667, and 707 mμ) and a weaker component at ~570 mμ. The question of whether the weak band or triplet is the F band is discussed. It is concluded that the F band may be related to the cesium ion and not to the type of lattice. (D.L.C.)

22339 DETECTION OF OXYGEN-17 N.M.R. IN SOLID MgO. Jasper A. Jackson (Los Alamos Scientific Lab., N. Mex.). Phys. Chem. Solids, 24: 591-2(Apr. 1963). (LADC-5570). (In English)

The detection of the nuclear magnetic resonance (NMR) of O^{17} in solids is difficult owing to the broadening from electric quadrupole interactions. A choice of a crystal lattice in which the oxygen is located at a site with cubic symmetry should reduce the quadrupole interaction. Searches for the NMR of O^{17} in pure MgO and MgO doped with 1% MnO_2 were successful, and the best traces are shown. (D.L.C.)

22340 STATISTICS OF PARTICLE DIFFUSION IN SPHERICAL GEOMETRY. B. T. McClure (Minneapolis-Honeywell Research Center, Hopkins, Minn.). Phys. Rev., 130: 1295-1300(May 15, 1963).

The diffusion of particles from the center of a sphere of radius R is considered theoretically. An expression is obtained for the probability that a particle will be collected at a small probe within the sphere rather than at the surface. This result forms the basis for an experiment to determine the momentum transfer cross section Q_m for electrons in a gas. The only parameter which must be known in order to obtain absolute cross sections by the technique proposed is the acceptance coefficient for electrons at the probe. The probability A_c that a particle will have exactly c collisions characterized by a constant cross section Q before striking the surface of the sphere for the first time is evaluated. It is assumed that these collisions are not correlated with the diffusion process. In contrast with previous work the present method takes into account the variation of total diffusion time as well as the probability of a particular number of collisions during a given time. The probabilities A_0, A_1, and A_2 are given in terms of elementary functions and a recursion relationship is given for the other A's. The expression $A_0 = y \operatorname{csch} y$ (where $y = RN(3QQ_m)^{1/2}$ and N is the gas density) is useful in an experiment to determine the cross section for inelastic collisions between electrons and gases. The probability of more than any given number of collisions, the average number of collisions, and the mean-square deviation from this average are also evaluated. (auth)

22341 GENERALIZED SELF-CONSISTENT FIELD THEORY AND THE DIELECTRIC FORMULATION OF THE MANY-BODY PROBLEM. Morrel H. Cohen (Univ. of Chicago). Phys. Rev., 130: 1301-9(May 15, 1963).

A generalized self-consistent field (SCF) theory of many-particle systems is developed by modifying the usual functional relationship between energy and wave function. A parameter ξ, $0 \leq \xi \leq 1$, is thus introduced into the energy so that for $\xi = 0$, the particles interact only with a self-consistent field, for $\xi = 1$ the particles interact dynamically among themselves with the correct field, and for intermediate values of ξ both SCF and dynamical interactions occur. A systematic development of the theory is given for time-independent and time-dependent problems, for finite temperatures, and for both uniform and nonuniform systems. The derivative with respect to ξ of the total energy, or free energy, is expressed in terms of the dielectric function; and an improved version of the dielectric formulation of the many-body problem is thereby obtained. A brief discussion of the advantages of the method, possible applications, and further generalizations or extensions is included. (auth)

22342 DIELECTRIC FORMULATION FOR MANY-PARTICLE SYSTEMS WITH GENERAL INTERACTIONS. Pedro Pascual and L. M. Falicov (Univ. of Chicago). Phys. Rev., 130: 1310-11(May 15, 1963).

An extension of the self-consistent field approach formulation by Cohen in the preceding paper is proposed in order to include the most general kind of two-body interactions, i.e., interactions depending on position, momenta, spin, isotopic spin, etc. The dielectric function is replaced by a dielectric matrix. The evaluation of the energies involves the computation of a matrix inversion and trace. (auth)

22343 COMMENTS ON THE EXISTING THEORIES OF MAGNETIC EFFECTS ON SUPERCONDUCTING FILMS. B. Y. Tong (Univ. of Hong Kong, China). Phys. Rev., 130: 1322-3(May 15, 1963).

The Gupta-Mathur theory and the Douglass theory, following the Ginzburg-Landau approach, are shown to merge into each other if the conditions of validity are taken into more careful consideration. (auth)

22344 BOLTZMANN EQUATION FOR POLARONS. Leo P. Kadanoff (Univ. of Illinois, Urbana). Phys. Rev., 130: 1364-9(May 15, 1963).

The Feynman description of the polaron is used to write a polaron Boltzmann equation. This equation is then used to discuss the drift mobility problem. In the limit of low temperatures, the Boltzmann equation is rearranged to

exhibit elastic resonance scattering and it is solved exactly. The evaluation of the drift mobility thus obtained is compared with the results of other calculations. Other applications of the polaron Boltzmann equation are briefly discussed. (auth)

22345 RATE OF CAPTURE OF ELECTRONS INJECTED INTO SUPERCONDUCTING LEAD. Allen Rothwarf and Michael Cohen (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 130: 1401-5(May 15, 1963).

The lifetime against capture into a Cooper pair of an electron injected into a superconductor is calculated. The electrons are assumed to have momenta close to the Fermi momentum, and the electron-phonon interaction, which causes a change in the momentum of the electron accompanied by emission of a phonon, is assumed to be responsible for the capture. Umklapp processes, in which the lattice takes up some momentum, seem to dominate the rate. The matrix element for Umklapp processes is determined from the experimentally measured high-temperature resistivity. The lifetime of an electron injected into lead at 1.44°K is calculated as 1.67×10^{-8} sec. (auth)

22346 ISING MODEL WITH A LONG-RANGE INTERACTION IN THE PRESENCE OF RESIDUAL SHORT-RANGE INTERACTIONS. George A. Baker, Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 130: 1406-11(May 15, 1963). (LADC-5604)

In the limit as the range of part of the interspin interaction becomes indefinitely great, but is still small compared to the size of the system, the behavior of Ising models that have, in addition, a residual short-range interaction is investigated. The only possible type of transition in this limit is found to be the familiar Bragg-Williams type. The passage of the three-dimensional Ising model on the simple cubic lattice to the long-range limit from the short-range limit, dimension by dimension, is also investigated. (auth)

22347 QUANTUM-MECHANICAL CALCULATION OF THE THIRD VIRIAL COEFFICIENT OF He^4. Sigurd Yves Larsen (Columbia Univ., New York). Phys. Rev., 130: 1426-40(May 15, 1963).

Using the method of binary collisions, the third virial coefficient of He^4 at low temperatures is calculated for a potential consisting of an attractive square well and a repulsive core. The shape of this potential is chosen so as to optimize the fit of the second virial coefficient with experimental data. From a comparison of the results with the third virial data the existence of a three-body bound state is inferred. A binding energy of 0.26°K, calculated from the potential, brings the adjusted results and the experimental data into agreement. (auth)

22348 CALCULATION OF ATOMIC HYPERFINE STRUCTURE CONSTANTS FROM PROJECTED UNRESTRICTED HARTREE-FOCK FUNCTIONS. CONSTANTS OF F^{19}. N. Bessis, H. Lefebvre-Brion and C. M. Moser (Centre de Mecanique Ondulatoire Appliquee, Paris). Phys. Rev., 130: 1441-3(May 15, 1963).

The magnetic hyperfine constants for the $^2P_{\frac{1}{2}}$ and $^2P_{\frac{3}{2}}$ states of F^{19} are calculated from the projected unrestricted Hartree-Fock (UHF) function where the orbitals are linear combinations of analytic functions. Neglecting the nonorthogonality between the radial parts of spin α and spin β functions, the values obtained are (experimental results are given in parentheses): $a' = 2031$ Mc/sec (2010 Mc/sec), $a''' = 522$ Mc/sec (446 Mc/sec), $a'' = 9952$ Mc/sec (10 244 Mc/sec). The contribution coming from the Fermi contact operator calculated from the projected UHF function is in much better agreement with experiment than that calculated either from the UHF or configuration interaction functions. (auth)

22349 ENERGY AND ANGULAR DEPENDENCE OF THE DIFFERENTIAL CROSS SECTION FOR PRODUCTION OF ELECTRONS BY 50-100 kev PROTONS IN HYDROGEN GAS. C. E. Kuyatt and T. Jorgensen, Jr. (Univ. of Nebraska, Lincoln). Phys. Rev., 130: 1444-54(May 15, 1963).

Hydrogen gas in a rotatable scattering chamber was bombarded by 50, 75, and 100-kev protons. The resulting secondary electrons were analyzed in both direction and energy by a slit system and a cylindrical electrostatic analyzer and counted by an electron multiplier tube with suitable electronics. Relative values of the differential cross section for ejection of secondary electrons were measured for 4 to 300-ev electrons at angles of 23°, 45°, 67.5°, 90°, 112.5°, 135°, and 152° from the proton direction. Absolute values for the differential cross sections were obtained by integration of the 50-kev results over all angles and energies and normalizing to the total ionization cross section measured by Schwirzke. As a function of electron energy, at a fixed angle, the differential cross sections show a broad peak at 4 to 8 ev with a monotonic decrease at higher electron energies. As a function of angle, for fixed electron energy, most of the differential cross sections are largest at 23°, drop off rapidly to about 100°, and are then relatively constant. The differential cross sections were integrated in various ways to obtain cross sections differential only in energy and in angle, total cross sections for ionization, average energies of the ejected electrons, and the stopping cross section due to ionization. Comparisons are made with other experimental results and with Born approximation calculations. (auth)

22350 MILLIMETER-WAVE AMPLIFICATION BY RESONANCE SATURATION. Benjamin Senitzky, Gordon Gould, and Sylven Cutler (TRG, Inc., New York). Phys. Rev., 130: 1460-5(May 15, 1963).

The nonlinear properties of a power-saturated resonant medium are used to obtain amplification of millimeter-wave radiation. Experiments demonstrating this effect are performed with the 3.5-mm rotational resonance of hydrogen cyanide ($HC^{12}N^{15}$) gas. An incoming radiation spectrum consisting of a strong saturating component at 3.5 mm and weak sidebands is transmitted through a gas-filled, $\frac{3}{4}$-in.-diam, 20-ft circular waveguide operated in the TE_{01} mode. Under certain conditions power can be transferred from the strong saturating component to the weak sidebands. A sideband gain with a maximum value of 1.5 dB is measured when the sidebands are phased for amplitude modulation and the saturating component input power is 4.8 mW. The bandwidth for this type of amplification is equal to the power-broadened linewidth. Sidebands phased for frequency modulation are always attenuated. The experimental results are in agreement with computations based on the solution of the quantum-mechanical Boltzmann equation. These computations indicate that a single sideband can also be amplified. (auth)

22351 GRAVITATIONAL FIELD ENERGY AND g_{00}. Charles W. Misner (Princeton Univ., N. J.). Phys. Rev., 130: 1590-4(May 15, 1963).

One of the family of "generalized energy density" definitions being investigated by Komar, one for which the generalized energy density is made positive definite by use of minimal surfaces, is shown to lead to a total "generalized energy" which is undefinable for closed universes, is not conserved for some asymptotically flat spaces, and

is not the correct total energy for the Oppenheimer-Snyder collapsing star metric where the metric in a neighborhood of infinity is identically the Schwarzschild metric. (auth)

22352 INEQUIVALENT HAMILTONIAN FORMALISMS IN ELECTRODYNAMICS. Melvin Schwartz (Syracuse Univ., N. Y. and Adelphi Coll., Garden City, N. Y.). Phys. Rev., 130: 1595-1604(May 15, 1963).

In treating the electric dipole approximation of a charged particle undergoing self-interaction, it is shown how, in the cases of a charged free particle and a charged oscillator, the same equations of motion may be derived from two inequivalent Hamiltonian formalisms. The first formalism is the Dirac formalism of Schiller and Schwartz, which must be satisfied by all configuration space solutions generated by the total Hamiltonian. In order to ensure that the configuration space solutions are consistent with the latter formalism, the constraints must be recognized as imposing modifications on the commutation rules satisfied by averaged field variables. While the first formalism is general, the second formalism can be constructed only after solutions expressed in terms of a Fourier decomposition of the radiation field are obtained. The second formalism is an interaction picture formalism where the radiation field part of the total Hamiltonian is the generator of time translations. The latter formalism is used to give a new derivation of Kramers' integral for the zero-point level shift of an oscillator. Some asymptotic boundary conditions and a recent paper by Sokolov and Lysov are also discussed. (auth)

22353 FURTHER DISCUSSION OF THE ROLE OF ELECTROMAGNETIC POTENTIALS IN THE QUANTUM THEORY. Y. Aharonov (Yeshiva Univ., New York) and D. Bohm. Phys. Rev., 130: 1625-32(May 15, 1963).

A further discussion of the role of electromagnetic potentials in the quantum theory, aimed at clarifying some of the points made in earlier papers, is presented, and some extensions of these earlier ideas are indicated. In addition, the problem of subsidiary conditions and questions concerning the full observability of the potentials are examined. Certain recent objections of Belinfante and De Witt are answered. (auth)

22354 MASSIVE ELECTRODYNAMICS. G. Feldman and P. T. Matthews (Imperial Coll. of Science and Tech., London). Phys. Rev., 130: 1633-8(May 15, 1963).

The relation between gauge invariance, canonical quantization, and the photon mass is examined. It is found that gauge invariance does not require the bare photon mass to be zero. In fact, quantization in an arbitrary covariant gauge is only possible for massive photons. This is a generalization of the usual Fermi procedure. A similar generalization of the conventional Coulomb gauge quantization leads to a gauge-invariant, but noncovariant, theory of massive transverse photons. (auth)

22355 THEORY OF THE RANGE OF HOT ELECTRONS IN REAL METALS. Stephen L. Adler (General Electric Co., Schenectady, N. Y.). Phys. Rev., 130: 1654-66(June 1, 1963).

The equations of Quinn and Ferrell and of Quinn for the rate of energy loss of a hot electron in a free-electron gas are generalized to take solid-state effects into account. A general equation is derived, which in addition to a principal term that reduces to Quinn's result in the free-electron gas limit, contains terms that result from umklapp processes and local-field corrections. The additional terms are evaluated for aluminum on a one-OPW model and are found to result in a 16–30% decrease in the rate of energy loss. The effect of Fermi surface shape on the principal term is discussed in detail, with the aid of an exact recasting of the term into a form that explicitly shows its dependence on the equations of the energy surfaces. It is shown that nonspherical Fermi surfaces lead to an anisotropic hot-electron energy-loss rate, and that for certain shapes of Fermi surface the rate of energy loss is more singular than $(E_p - E_0)^3$ near the Fermi surface. It is found that the flatter the Fermi surface, the greater the rate of hot-electron energy loss. This is suggested as a possible explanation for the anomalously small hot-electron range observed in copper. (auth)

22356 SUPERCONDUCTIVITY IN THE MERCURY–INDIUM ALLOY SYSTEM. M. F. Merriam, M. A. Jensen, and B. R. Coles (Univ. of California, San Diego). Phys. Rev., 130: 1719-26(June 1, 1963).

The superconducting transition temperatures of a large number of Hg–In alloys were measured and the variation of T_c with composition determined over the entire range. Variation of T_c with number of valence electrons/atom within any particular metallurgical phase is quite strong, T_c in general increasing with decreasing number of valence electrons. The maximum and minimum values of T_c occurring in the system are 4.5 and 3.1°K at approximately 80 and 20 at. % indium, respectively. HgIn, the only stoichiometric compound, has a transition temperature of 3.81°K. The observed composition dependence of T_c is not what one would expect either from Matthias's empirical rules or from the simple BCS formula, assuming a nearly free electron model for the density of states. In one phase a discontinuity in T_c and its composition dependence is found that cannot be correlated with a change in any lattice property and apparently arises from a discontinuous change in electronic structure. In connection with the problem of the effect of one phase upon superconductivity in another with which it is in intimate contact, there is evidence that the transition temperature of HgIn can be lowered a few tenths of a degree if large quantities of a lower transition temperature phase are also present. Electrical conductivity data, which were obtained in the course of the superconductivity measurements by an induced-current method, made possible also the determination of residual resistivity over the entire composition range. (auth)

22357 CRITICAL FIELDS OF THIN SUPERCONDUCTING FILMS. II. MEAN FREE PATH EFFECTS IN INDIUM–TIN ALLOY FILMS. A. M. Toxen and M. J. Burns (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 130: 1808-15(June 1, 1963).

Mean free path effects as well as thickness effects on critical fields of thin superconducting films are discussed, and the results are found to be in good agreement with critical field measurements on thin alloy films of indium containing 0–4.6 at. % tin. The coherence length, ξ, was calculated for each film from measurements of resistivity and thickness, and is found to vary from 2600 Å at 0 at. % Sn to 1000 Å at 4.6 at. % Sn. Also, the question of whether size effects in thin films are equivalent to mean free path effects is discussed in detail. It is concluded that isze effects are not equivalent to mean free path effects, or more precisely, boundary scattering is not equivalent to scattering by randomly distributed defects. In fact, it is demonstrated that whereas the London or local limit obtains in the presence of high concentrations of randomly distributed defects, the Pippard or nonlocal limit obtains in very thin films, where boundary scattering predominates. (auth)

22358 PROTON-LATTICE INTERACTIONS IN HYDROGEN-BONDED FERROELECTRIC CRYSTALS. R. Blinc

and M. Ribaric (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). Phys. Rev., 130: 1816-21(June 1, 1963).

The distortions of the lattice accompanying protonic order-disorder transitions, and the difference between the observed frequency of protonic or deuteronic intrabond motion and the one estimated on the basis of the rigid lattice model, seem to indicate that proton-lattice interactions are not negligible in the case of ferroelectric H-bonded crystals. The energy spectrum and polarizability of an isolated hydrogen-bonded proton, interacting with polar lattice vibrations in the presence of an electric field, were studied both in the strong and in the weak-coupling limits. The results obtained show that the intrabond tunneling frequency of a proton, interacting with the lattice, is in fact much smaller than the tunneling frequency of a bare proton in an undeformed lattice. In the case of strong proton-lattice interactions, the polarizability is anomalously large at relatively low field strengths and any small fluctuation in the lattice potential is accompanied by a trapping of the proton in an off-center position. Another specific consequence of proton-lattice interactions is an inherent distribution of dipolar relaxation times. (auth)

22359 DISPLACEMENT CROSS SECTIONS FOR FAST ELECTRONS INCIDENT ON GOLD. G. S. Khandelwal and E. Merzbacher (Univ. of North Carolina, Chapel Hill). Phys. Rev., 130: 1822-5(June 1, 1963).

The displacement cross section for electrons producing radiation damage in solids was computed, using the Mott series for relativistic Coulomb scattering. The results are compared with the widely used formula of Seitz and Koehler, based on a low-Z approximation due to McKinley and Feshbach. For low-Z elements, the formula of Seitz and Koehler was found to be accurate. For gold the displacement cross section computed from the Mott series is, in the region of 2–4 Mev bombarding energy, about twice as large as the value obtained from the approximate formula. The behavior of the cross section near threshold and at very high energies was considered. For high-Z values the displacement cross section shows predominantly a parabolic rise near threshold. At very high energies it falls slowly toward a finite value. The implications of these calculations for various experiments on radiation damage in gold are briefly discussed. (auth)

22360 CHARGE EXCHANGE AND DISSOCIATION OF H^+, H_2^+, AND H_3^+ IONS INCIDENT ON H_2 GAS. G. W. McClure (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 130: 1852-9(June 1, 1963). (TID-17801; SCDC-2998)

A unified set of measurements of the yield cross sections for the various fast charged and neutral atomic particles produced in single collisions of H^+, H_2^+, and H_3^+ ions with H_2 gas molecules is presented. The fast particles in question result from the dissociation or charge neutralization of the primary ions and have essentially the same velocity as the primary ions. The measurements cover the energy range from 3 to 100 kev for H^+ primaries, 3 to 120 kev for H_2^+ primaries, and 5 to 120 kev for H_3^+ primaries. The yield cross sections of the various dissociation fragments of H_2^+ and H_3^+ primaries are found to vary as much as 20% with changes in ion source operating conditions. It is proposed that this variation is due to changes in the population of internal energy states of the primary ions. Results obtained for H_2^+ primary ions are compared with the results of other investigators. (auth)

22361 VARIATIONAL CALCULATION OF THE GROUND STATE OF THE LITHIUM ATOM. E. A. Burke (St John's Univ., Jamaica, N. Y.). Phys. Rev., 130: 1871-6(June 1, 1963).

The ground state of the lithium atom is calculated using wave functions containing interelectronic separation terms. A 13-term properly symmetrized variational function is employed yielding a ground-state energy of −14.9559 in units of $e^2/2a_0$ as compared to the previous best value of −14.9542 using the superposition of 45 configurations and the experimental value of −14.9561. A brief discussion of applications and extensions of the present work is given along with solutions of the integrals that occur. (auth)

22362 FORMATION OF COLOUR CENTRES IN UNDEFORMED AND DEFORMED NaCl. R. W. Davidge and P. L. Pratt (Imperial Coll. of Science and Tech., London). Phys. Status Solidi, 3: 665-70(1963). (In English)

Rates of F-center formation and absorption spectra after soft and hard x irradiation and after subsequent bleaching were studied. Two stages of coloration were found. During the first stage, F-centers were formed from vacancies present in the crystal prior to irradiation. The second stage during soft irradiation was attributed to the formation of F-centers by a bulk mechanism; the second stage during hard irradiation, which is significant only in deformed crystals, was attributed to the formation of F-centers from vacancy clusters generated by deformation. (auth)

22363 REMARKS CONCERNING THE CLASSICAL THEORY OF SCATTERING AND MODELS OF THE "HARD SPHERE" TYPE. R. Frère (CEN, Mol, Belg.). Phys. Status Solidi, 3: 712-25(1963). (In French)

Collisions between atomic systems are often discussed in terms of a "billiard ball" model. An exact solution of this scattering problem is obtained by the use of perturbation theory. From the exact solution it is found that the scattering process can be described in terms of a general hard-core-type model which will be superior to the simple billiard ball model in describing real processes. (auth)

22364 AC AND DC POLARIZATION EFFECTS IN A PROTONIC CONDUCTOR (BORAX). L. K. H. Van Beek (TNO, Delft, Netherlands). Physica, 29: 215-24(Mar. 1963). (In English)

Protonic polarization effects in (a-c) in borax were studied by dielectric measurements between 1c and 300kc. At very low frequencies a conductivity loss was observed corresponding with a resistivity $\rho = 3.8 \times 10^6$ ohmm. The rest of the dispersion could be resolved into two overlapping contributions I and II with relative dielectric constants changing from $\kappa'_s = 575$ at very low frequencies to $\kappa'_\infty = 4$ at high frequencies. Loss mechanism I was ascribed to mobile protons and Macdonald's theory of a-c space-charge polarization was applied to calculate the mobility μ and the proton concentration N. Loss mechanism II was attributed to proton displacements over molecular distances. Polarization effects (d-c) were studied at constant field strengths between 200 and 8×10^4 v/m. The currents all showed an exponential decrease with a characteristic time T = 300 sec, independent of the applied voltage and followed by a much slower decrease with a characteristic time $\tau' = 2 \times 10^4$ sec. This was ascribed to a finite rate of discharge of protons and space-charge formation. From space-charge limited currents the same mobility was calculated as from the dielectric measurements. The values $\mu = 1.8 \times 10^{-4}$ m^2/vs and $N = 10^{16}$ m^{-3} are consistent with all the experimental observations. (auth)

22365 PREPARATION OF A HIGH MAGNETIC FIELD USING Nb–Zr ALLOY. E. M. Savitskii, V. V. Baron,

V. R. Karasik, S. Sh. Akhmedov, V. Ya. Pakhomov, and M. I. Bychkova (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 182-3(Jan.-Feb. 1963). (In Russian)

Studies of the superconducting properties of a Nb–25% Zr wire showed that with a 1-cm ID winding and a volume of 80 cm^3 the maximum magnetic field intensity in the center of a solenoid is ~60 k gauss at 4.2°K. (R.V.J.)

22366 DISCONTINUITY OF MAGNETOHYDRODYNAMIC BOUNDARY LAYER. A. B. Vatazhin. Prikl. Mat. i Mekhan., 27: 338-42(Mar.-Apr. 1963). (In Russian)

An approximation relation was developed that connects external flux parameters, boundary layer thickness, and electromagnetic magnitudes at a cross section of a laminar magnetodynamic boundary discontinuity. Two-dimensional boundary layers on a surface or on a channel wall were analyzed. (R.V.J.)

22367 SOME RELATIVISTIC FIELDS OF ELECTROMAGNETIC AND GRAVITATIONAL RADIATION. S. N. Pandey and J. Krishna Rao (Banaras Hindu Univ., Varanasi, India). Proc. Natl. Inst. Sci. India. Pt. A, 28: 425-36(May 26, 1962). (In English)

Einstein's field equations for empty space-time admit solutions, in the linear approximation, that may be interpreted as describing plane gravitational waves. In order to study the non-linear effects, the linearized field is considered as a starting point for exact calculations and its gravitational significance is examined in the light of Einstein's field equations. The perfect fluid hypothesis leads to a new metric form for the Einstein universe. When the metric potentials are functions of the argument $t \pm x$, they describe null electromagnetic fields. In particular, a space-time metric for a uniform null electromagnetic field was obtained. The empty significance conditions lead, in general, to fields of pure gravitational radiation. The physical significance of a particular solution, describing gravitational radiation, was discussed by means of equations of geodesics and geodesic deviations. It is also shown that the gravitational waves possess a positive pseudo-energy density. (auth)

22368 A COMPOSITE FIELD IN EINSTEIN'S UNIFIED FIELD THEORY. Ramji Tiwari and S. R. Roy (Banaras Hindu Univ., Varanasi, India). Proc. Natl. Inst. Sci. India. Pt. A, 28: 445-56(May 26, 1962). (In English)

A composite field that reduces to the field of a plane electromagnetic wave in the absence of an electron while it reduces to the field of an electron in the absence of the plane wave is considered. It is found that to the second order of approximations the two electromagnetic fields do not interact although there exists their gravitational interaction. The gravitational field equations are found to be consistent. In the absence of the plane wave the field equations provide a solution for the gravitational field of an electron that resembles Moffat's solution. (auth)

22369 GENERALIZED THEORY OF SPINORS. N. N. Ghosh (Indian Ass'n. for Cultivation of Science, Calcutta). Proc. Natl. Inst. Sci. India. Pt. A, 28: 695-709(Sept. 26, 1962). (In English)

Generalized spinors are entities in a non-analytic complex manifold obeying characteristic transformation laws. Starting with the general co-ordinate transformation scheme in a real 4-space R_4 it is shown that there exists a (1-1) correspondence between tensors in R_4 and spinors in the non-analytic 2-dimensional complex space S_2 auxiliary to R_4. Further, this correspondence is seen to be preserved if R_4 is specialized. Thus the full Lorentz group in a 4-space admits of a spinor representation with (1-1) correspondence in a non-analytic 2-dimensional complex space. (auth)

22370 THE GRAVITATIONAL AND ELECTROMAGNETIC FIELDS DUE TO ROTATING BODIES IN GENERAL RELATIVITY. Ramji Tiwari and Markandeya Misra (Banaras Hindu Univ., India). Proc. Natl. Inst. Sci. India. Pt. A, 28: 771-9(Sept. 26, 1962). (In English)

A metric that is supposed to describe the field due to bodies in stationary rotation about their axes is considered, and it is shown that in canonical co-ordinates this metric is incompatible with the perfect fluid hypothesis. The metric in this case is, however, compatible with a stationary electromagnetic field that seems to support Blackett's hypothesis. In this case a consistent set of equations for determining the metric potentials in empty space-time is obtained. A class of exact solutions of these equations is obtained. It is also shown that if canonical co-ordinates are not used the metric can represent perfect fluid distributions. (auth)

22371 A PARTICULAR SOLUTION OF THE GRAVITATIONAL EQUATIONS OF A COMPOSITE FIELD IN EINSTEIN'S UNIFIED FIELD THEORY. Ramji Tiwari and S. R. Roy (Banaras Hindu Univ., India). Proc. Natl. Inst. Sci. India. Pt. A, 28: 780-6(Sept. 26, 1962). (In English)

A particular solution up to the second order of approximations of the gravitational equations of a composite field in Einstein's Unified Field Theory was obtained. The field considered is such that it reduces to the field of an electron at rest in the absence of the plane polarized electromagnetic wave and the same field reduces to the latter in the absence of the electron. The solution contains real singularities along the negative side of the x-axis in addition to the singularity at the origin. (auth)

22372 A THEORETICAL INVESTIGATION OF PLURAL AND MULTIPLE SCATTERING OF ELECTRONS BY AMORPHOUS FILMS, WITH SPECIAL REFERENCE TO IMAGE CONTRAST IN THE ELECTRON MICROSCOPE. G. H. Smith and R. E. Burge (Kings Coll., London). Proc. Phys. Soc. (London), 81: 612-32(Apr. 1, 1963).

A method of performing the integrations of the plural and multiple scattering of electrons by amorphous films is developed here, taking both elastic and inelastic scattering into account. The method enables equations to be derived in closed form for the angular distribution of scattered electrons. It is assumed that the scattering films are composed of spherically symmetrical, isolated, neutral atoms. The integrations are made possible by fitting the variation with scattering angle of the total mass-scattering cross section S_t for single scattering with a summation of Gaussian terms. Since the fitting parameters occur in the final equations, this method is extremely flexible and allows the most accurate data for S_t which are available to be incorporated. A mass-scattering cross section S_p is defined so that when substituted for S_t in the single-scattering theory the effects of plural scattering are incorporated. Under certain conditions S_p is found to be identical with S_t, and the equation giving the total fraction of the beam scattered by the film reduces to that given by Zeitler and Bahr. As examples representative of the elements of the periodic table, the theory is applied to carbon and gold films. The variations of the angular distribution of scattered electrons and their effect on electron diffraction patterns and image contrast in the electron microscope are determined for various film thicknesses. Electron energies in the range 20 to 500 kev, and electron-microscope objective apertures of semi-angle

$0-2 \times 10^{-3}$ radian are considered. Comparisons are made between the calculated results, the Lenz theory, and the experimental data that are available. The maximum thickness to which the single-scattering theory can be applied is examined and compared with definitions based on the electron mean free path in the film. Methods of improving the accuracy of the theoretical results are discussed. (auth)

22373 REARRANGEMENT COLLISIONS. III. ELECTRON TRANSFER FROM ATOMS TO FAST PROTONS. M. H. Mittleman (National Aeronautics and Space Administration, Greenbelt, Md.). Proc. Phys. Soc. (London), 81: 633-41(Apr. 1, 1963).

The high energy rearrangement collision, in which a fast proton incident upon an atom picks up an electron, is considered. It is found that with the present understanding of rearrangement collisions the cross section can be given for any atom in a restricted energy region with some theoretical uncertainty due to higher order collisions. (auth)

22374 IONIZATION GROWTH TIMES AND SECONDARY PROCESSES IN HELIUM. D. Kenneth Davies, F. Llewellyn Jones, and C. G. Morgan (University Coll. of Swansea, Eng.). Proc. Phys. Soc. (London), 81: 677-81 (Apr. 1, 1963).

Formative times t_f of ionization growth in uniform electric fields E were measured for spectroscopically pure helium at pressures p (~ cmHg) between plane parallel silver electrodes in the range $8.61 \leq E/p \leq 38.08$ v cm^{-1} $(mmHg)^{-1}$ over which the observed growth times lay between 10^{-3} and 10^{-1} sec for over-voltages of the order of 5% of the static sparking potential V_s. Quantitative analysis of the experimental data showed that the observed slow growth rates could not be accounted for, over the whole range investigated, by the action of secondary processes based on secondary cathode emission due to the incidence of unscattered photons, of positive ions, or of metastable atoms either separately or in any combination of these separate processes. (auth)

22375 THE PENETRATION OF ELECTRONS INTO LUMINESCENT MATERIALS. W. Ehrenberg and D. E. N. King (Birkbeck Coll., London). Proc. Phys. Soc. (London), 81: 751-66(Apr. 1, 1963).

The glow (penetration figure) produced in a number of phosphors by a narrow bundle of cathode rays is studied, and values are obtained for the ranges of electrons of energies between 10 and 80 kev and the energy losses. The ranges are proportional to the integrated path lengths as given by Bethe's formula; the energy losses are in satisfactory agreement with the theoretical values recently tabulated by Spencer. (auth)

22376 THE ASYMPTOTIC FORM OF THE ELECTRON CAPTURE CROSS SECTIONS. C. J. Cook (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 81: 789-90(Apr. 1, 1963).

The validity of the Born formulas for the cross section for electron capture by light ions is investigated. (C.E.S.)

22377 MACH'S PRINCIPLE AND THE CREATION OF MATTER. F. Hoyle (St. John's Coll., Cambridge, Eng.) and J. V. Narlikar. Proc. Roy. Soc. (London), Ser. A, 273: 1-11(Apr. 23, 1963).

Accurate experiments have shown that the local inertial frame is the one with respect to which the distant parts of the universe are non-rotating. This coincidence, first noticed by Newton, later led to the formulation of Mach's principle. It is known that relativity theory by itself cannot explain this coincidence. The introduction of a scalar creation field into the theory is likely to improve the situation. Calculation shows that the continuous creation of matter has the effect of smoothing out any irregularities in the universe as it expands, while rotation, if present, becomes less and less. This explains the observed remarkable degree of homogeneity and isotropy in the universe. (auth)

22378 THE DENSITY MATRIX IN MANY-ELECTRON QUANTUM MECHANICS. III. GENERALIZED PRODUCT FUNCTIONS FOR BERYLLIUM AND FOUR-ELECTRON IONS. R. McWeeny and B. T. Sutcliffe (Univ. of Keele, Eng.). Proc. Roy. Soc. (London), Ser. A, 273: 103-16 (Apr. 23, 1963).

The theory of generalized product functions is extended to non-orthogonal group functions in the case of two groups. Calculations on beryllium and on some four-electron ions are based on such group functions, and are compared with similar calculations using orthogonal group functions. It is shown that, in the case of the systems examined, the strong orthogonality restriction is not severe. (auth)

22379 DETERMINATION OF THE CRITICAL TEMPERATURE OF A SUPERCONDUCTOR. V. A. Moskalenko (Inst. of Physics and Mathematics, Academy of Sciences, Kishinev, USSR). Soviet Phys.-Solid State (English Transl.), 4: 2032-6(Apr. 1963).

The critical temperature T_c is considered to be the point at which the bound state of a particle or hole pair occurs in superconducting metals. From the condition that the binding energy of the pair is equal to zero, T_c is found by solving the Bethe-Salpeter equation. The calculation is made on Frölich's model, enlarged by including the Coulomb interaction between electrons. A relation is found between the criteria for superconductivity and the stability of the lattice to one-phonon excitations. (auth)

22380 INVESTIGATION OF AN ELEMENTARY EVENT OF X-RAY PHOTOEFFECT BY ANALYZING THE PULSE-HEIGHT DISTRIBUTION AT THE OUTPUT OF A SECONDARY ELECTRON MULTIPLIER. V. N. Shchemelev and M. A. Rumsh (Leningrad State Univ.). Soviet Phys.-Solid State (English Transl.), 4: 2048-52(Apr. 1963).

A method is proposed for determining the average number of electrons emitted during an x ray photoemission event. Results of the application of this method to Cu and Au photocathodes, and also to a number of dielectric surfaces, are given. In the case of the metals, the results are compared with results obtained from secondary electron emission experiments. A possible explanation of the emission properties is given in the case of the dielectric emitters. (auth)

22381 ELECTRODYNAMICS OF SUPERCONDUCTORS. V. Z. Kresin (Moscow State Pedagogical Inst.). Soviet Phys.-Solid State (English Transl.), 4: 2075-6(Apr. 1963).

A method for obtaining a gauge invariant expression for the density of superconducting current is described. (auth)

22382 MAGNETO-OPTICAL INVESTIGATION OF CRYSTALS IN STRONG MAGNETIC FIELDS. I. EXPERIMENTAL PULSE METHOD. V. V. Eremenko and Yu. A. Popkov (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 7: 88-95(Jan. 1963). (In Ukrainian)

A description is given of a simple pulse method for investigating magneto-optical phenomena of the Zeeman type in strong magnetic fields. The proposed method consists essentially in photographing the spectrum of the crystal in bright, brief (~10^{-5} sec) flashes of light synchronized with the maximum pulse of the magnetic field. The field is created by a battery discharge through a small-sized

solenoid containing the investigated crystal and cooled by liquid helium, hydrogen, or nitrogen directly in the optical Dewar. The Zeeman effect in a CaF_2 + Ho crystal is presented as an example of the possibility of magneto-optical investigations in magnetic fields of up to 150,000 oersteds. (auth)

22383 A NEW METHOD FOR CONVERTING EXPERIMENTAL X-RAY SCATTERING INTENSITIES TO AN ABSOLUTE SCALE. M. I. Gulivets and I. V. Radchenko (Dnepropetrovsk Metallurgical Inst., USSR). Ukr. Fiz. Zh., 7: 106-8(Jan. 1963). (In Ukrainian)

A new method for converting experimental x ray scattering intensities to an absolute scale is proposed. An expression for the normalizing factor is obtained on the assumption that the number of the scattering centers in a sufficiently large volume is constant. (auth)

22384 ON PHENOMENA AT A PLASMA DIODE CATHODE USED AS A MODEL MAGNETOGASODYNAMIC POWER CONVERTER. N. D. Morgulis (Kiev State Univ.). Ukr. Fiz. Zh., 7: 1134(Jan. 1963). (In Ukrainian)

Magnetogasodynamic conversion of thermal energy into electric energy was studied using an approximation model of a thermoelectron diode introduced into an independently produced plasma. The current induced at the cathode-plasma boundary by the cathode thermo-electron current, in addition to that induced by the plasma ion current, was analyzed. The volt-ampere characteristics of the diode were evaluated, and the feasibility of current increase by thermoelectrical emission from a cathode was indicated. (R.V.J.)

22385 ON THE UNSTEADY MOTION OF A VISCOUS HYDROMAGNETIC FLUID CONTAINED BETWEEN ROTATING COAXIAL CYLINDERS OF FINITE LENGTH. Milomir M. Stanišić (Purdue Univ., West Lafayette, Ind.). Z. Angew. Math. Mech., 42: 269-79(July-Aug. 1962). (In English)

The problem of unsteady rotational motion of an electrically conducting viscous, incompressible fluid, contained within two axially concentric cylinders of finite length in the presence of an axial symmetric magnetic field of constant strength, was solved exactly using finite Hankel transforms in combination with a technique presented. A complete solution is presented for the problem under consideration. Moreover, the Pneuman-Lykoudis solution in magnetohydrodynamics and Ghildyal solution in hydrodynamics appears as a special case of this study. The analysis shows that the disturbance in the fluid disappears quickly by increasing the magnetic field. (auth)

22386 SIMPLE ARRANGEMENT FOR THE ANALYSIS OF GEOMETRIC DATA OF CHARGED PARTICLE BEAMS. Manfred Fink, Klaus Jost, and Joachim Kessler (Technische Hochschule, Karlsruhe, Ger.). Z. Angew. Phys., 15: 112-14(1963). (In German)

An apparatus for the analysis of the geometric data of charged particle beams was described. With the device, the diameter, aperture angle, current density distribution, and variation of current density distribution along the beam axis can be determined. The method is simple and usable since commercial construction elements of television technology, which are highly developed and reasonable, are used. The beam to be studied was led synchronously with the output of a television picture tube over a fine diaphragm. The beam fraction penetrating the diaphragm controls the brightness of the electron beam in the picture tube by the Y amplifier of a cathode ray oscillograph. The oscillograph tube then shows an intensity picture of the beam for quantitative measurements while a greatly enlarged picture of the beam cross section studied appears on the television tube. (tr-auth)

22387 ION COUNTING WITH ALLEN MULTIPLIER AND COMMERCIAL COUNTER INSTALLATION FOR INTENSITY MEASUREMENTS IN MASS SPECTROSCOPY. Horst E. Beske (Universität, Mainz). Z. Angew. Phys., 15: 114-16(1963). (In German)

Experiments with the Allen multiplier in combination with a commercial counter device for ion beam measurements were reported. The limits of application were given. The measurement range extends from 10^{-19} to 10^{-14} amp. The method was applied to intensity measurements on a mass spectroscope for trace analysis in solids. (tr-auth)

22388 EFFECT OF JOULE HEAT ON DESTRUCTION OF SUPERCONDUCTIVITY BY A CURRENT. S. Ya. Berkovich and G. M. Lapir (Inst. of Exact Mechanics and Calculating Techniques, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1329-32(Apr. 1963). (In Russian)

Distortion of the dependence of the resistance of superconducting cylindrical samples on temperature and current as a result of Joule heating is considered. The results obtained can be used to explain the deviation of the experimental data from the well-known London formula. (auth)

22389 DIRECTED COHERENT RADIATION DUE TO BREAKDOWN NEAR THE TRACK OF AN IONIZING PARTICLE. G. A. Askaryan (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1337-9(Apr. 1963). (In Russian)

Directed emission of radio waves produced as a result of breakdown near the track of an ionizing particle in a medium located in an electric field is considered. It is shown that a strong asymmetry of the radiation arises if the particle velocity is comparable to or exceeds the propagation velocity of the radio waves in the medium. It is pointed out that the effect can be used for obtaining a sharply directed radiation and also for determining the velocity of the particle initiating the breakdown by measuring the angle of maximum emission. (auth)

22390 THEORY OF FERMI FLUID. B. T. Geilikman (Moscow Inst. of Physics and Tech.). Zh. Eksperim. i Teor. Fiz., 44: 1340-8(Apr. 1963). (In Russian)

The ground state energy and other characteristics of a Fermi system are calculated by employing the Green function method and theory of Fermi fluids. The calculations are carried out for long range and short range potential components such that $n^{1/3} r_s \ll 1$ and $n^{1/3} r_l \gg 1$ where r_s and r_l are the ranges of action of the short- and long-range force components and n is the particle density. (auth)

22391 DETERMINATION OF SOME PARAMETERS IN HIGH-FREQUENCY RING DISCHARGE. E. A. Bamberg and S. V. Dresvin. Zh. Tekhn. Fiz., 33: 65-72(Jan. 1963). (In Russian)

A high-frequency ring discharge induced in air by a 60 Mc tube generator was studied. Measurements were made of the discharge conductance (at 2×10^{-2} to 150 mm Hg pressure) and of other electric discharge characteristics. (tr-auth)

22392 RESONANCE EXCITATION OF WAVES IN IDEALLY CONDUCTING FLUID. S. V. Iordanskii (Steklov Inst. of Mathematics, Moscow). Zh. Tekhn. Fiz., 33: 105-14(Jan. 1963). (In Russian)

Resonance excitation of one-dimensional oscillations in a limited-volume ideally-conducting fluid was studied using magnetohydrodynamic approximation. It is shown that

shock waves appear near the resonance frequency, and the rate of irreversible heating was calculated. (R.V.J.)

22393 THE NUCLEAR MAGNETIC RESONANCE STUDY OF LANTHANUM HYDRIDE. David Seyfarth Schreiber. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 154p.

The nuclear magnetic resonance of both the La and the H nuclei in lanthanum hydride has been studied as a function of H concentration and temperature. The concentrations ranged from 0.4 H/La to 2.85 H/La and temperatures, −197°C to 400°C. The existence of 2 phases, part La metal and part $LaH_{2.0}$ for concentrations with less than 2 H/La is confirmed. Measurements of the proton linewidth and thermal relaxation time, T_1, unambiguously demonstrate that proton self-diffusion takes place at moderate temperatures. Activation energies and attempt frequencies for the proton self-diffusion are determined as a function of H concentration. The self-diffusing protons have a pronounced effect (via a quadrupole interaction) on the La resonances. A detailed semiquantitative analysis incorporating the proton resonance data is made of these quadrupolar effects. The thermal relaxation time of the La resonance in $LaH_{2.0}$ is found to be the result of a conduction electron hyperfine interaction. A schematic picture of the band structure of the hydrides consistent with the available data is suggested, based on an ionized H atom or proton, whose electron goes into a conduction band localized in the La ion. (M.P.G.)

22394 ANGULAR MOMENTUM. D. M. Brink and G. R. Satchler. Oxford, Clarendon Press, 1962. 140p. $2.40.

New techniques in the quantum theory of angular momentum and its application to physical problems both in nuclear and atomic physics are presented and their physical significance explained. The topics covered include symmetry in physical laws, representations of the rotation group, coupling angular momentum vectors and transformation theory, tensors and tensor operators, and matrix elements of tensor operators. (C.E.S.)

22395 SOLUTION OF TWO MASTER EQUATIONS COUPLED BY PARTICLE EXCHANGE. Daniel B. Levine. Thesis, Washington, D. C., Catholic Univ. of America, 1962. 85p.

The equilibrium temperatures and stream velocities of two initially isolated systems are perturbed when it is made possible for particles to jump from one system to another. The situation is described analytically by writing down for each system a Master equation containing a coupling term to describe the probability of particle exchange. The Gaussian transition probability is incorporated to describe the effect of collisions within each system, and an effusive flow transition probability is used to describe particle exchange. Approximate solution of the two coupled Master equations yields the particle velocity distributions, which are used to calculate the departure of the steady-state temperature and stream velocity from the equilibrium values, i.e., the values prior to switching on particle exchange. In particular, the effect of the equilibrium stream velocity in one system upon the steady-state temperature in the other system is discussed. (Dissertation Abstr.)

22396 RELATIVISTIC CORRECTIONS IN STATISTICAL MECHANICS FOR A SYSTEM OF CHARGED PARTICLES. John Ernest Krizan. Thesis, Bethlehem, Penna., Lehigh Univ., 1962. 77p.

Relativistic effects for systems of interacting particles are studied. The noninstantaneous nature of the forces leads to dynamical equations, which can not be treated by known mathematical methods; however, the interaction terms can be expanded to obtain a description of the system in terms of the positions and their derivatives of all orders at a single time. If one stops at the $(v/c)^2$ approximation, a specification in terms of positions and velocities is obtained. In electrodynamics this corresponds to the Darwin Hamiltonian. A system described by this Hamiltonian is investigated with the methods of equilibrium statistical mechanics. The cluster expansion with subsequent summation of diagrams as employed by Mayer for the Coulomb case is used; the modifications necessary due to the presence of momentum-dependent terms in the interaction are developed. Taking the lowest-order nonvanishing (ring) approximation, the relativistic corrections to the Debye-Hückel law are sought. However, mathematical difficulties peculiar to the relativistic interactions force restriction to calculation of the relativistic short-range correlation effects in the charged system. The results include a modified Debye-Hückel law with relativistic correction. This correction is small compared to the static one. At the high temperatures required for appearance of relativistic effects, the static term is nonnegligible only at very high densities. Consequently the relativistic contribution can in effect be neglected in this approximation. (Dissertation Abstr.)

22397 MEASUREMENT OF TOTAL CROSS SECTIONS FOR THE SCATTERING OF LOW ENERGY ELECTRONS BY LITHIUM. Julius Perel. Thesis, New York, New York Univ., 1962. 147p.

The atomic-beam recoil technique is used to measure the total cross sections for the scattering of electrons by Li, in the energy range of about 1 to 9 ev. In this method, the atom beam is crossfired by a modulated, "monochromatic" electron beam. Atomic recoil results in a scattering out of the atom beam at the modulation frequency. A phase-sensitive, lock-in system is used to detect the atom scattering signal, which is obtained from a continuously oxygenated surface ionization detector, the output of which is proportional to the product of total collision cross section, electron current, and total beam intensity. A relative total cross section curve (unnormalized) is then obtained by plotting detector output per unit electron current per unit beam intensity as a function of electron energy. The Li scattering signal is compared to a K scattering signal at each energy at which measurements are made. The Li scattering-cross-section curve is then plotted relative to the K curve. The general shape of the Li curve is quite similar to that of the K curve over the range studied. The cross-section values range from about 50 to 70% of the K values in the 1 to 9 ev region. In the 1 to 3 ev region the errors for Li are too large to ascertain the existence of a resonance, such as appears in this range in the cross-section curves of the other alkalies. (M.P.G.)

22398 NUCLEAR MAGNETIC RESONANCE IN LIQUID HELIUM THREE NEAR THE MELTING CURVE. Harold Weinstock. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 109p.

Nuclear magnetic resonance was used to measure the longitudinal relaxation (T_1) of liquid He^3 near the melting curve. At temperatures below the temperature of the melting curve minimum, T_{min}, and pressures above the pressure of the melting curve minimum, P_{min}, a blocked capillary technique provided accessibility to the liquid region. The amount of He^3 gas leaving the pressurizing system was continuously monitored to determine whether the capillary remained blocked. For pressures up to and including 29.95 atm, the capillary remained blocked throughout the measurements, and T_1 was found to be between 1 and 2 min. The nuclear paramagnetic susceptibility in this region behaved in a manner similar to that of high pressure liquid below the melting curve. There was no evidence of the much

shorter relaxation times observed by Anderson, et al. for pressures above P_{min} and temperatures below T_{min}. For pressures above 30 atm, it was found impossible to maintain a blocked capillary, and relaxation behavior characteristic of a mixture of solid and liquid He^3 was observed. These results agree with Fairbank's analysis of the anomalous behavior reported for liquid He^3 near the negative slope of the melting curve. (Dissertation Abstr.)

22399 A MECHANISM FOR THE SUPPORT OF SMALL PARTICLES IN THE VICINITY OF THE MESOPAUSE. Stig Arvid Rossby. Thesis, Madison, Wis., Univ. of Wisconsin, 1963. 40p.

It is shown that the Lorentz force exerted by the earth's magnetic field on a particle, positively charged by the emission of photoelectrons, is sufficient to support and concentrate such particles in the neighborhood of the mesopause. The particle sizes for which this mechanism is effective lie in the radius interval 10^{-5} to 10^{-6} cm. The particle sizes and heights of concentration are seen to be consistent with those inferred from studies of noctilucent clouds. (Dissertation Abstr.)

22400 CRYOGENIC MAGNETS. Richard F. Post and Clyde E. Taylor (to U. S. Atomic Energy Commission). U. S. Patent 3,090,894. May 21, 1963.

A cryogenic magnet coil is described for generating magnetic fields of the order of 100,000 gauss with a minimum expenditure of energy lost in resistive heating of the coil inductors and energy lost irreversibly in running the coil refrigeration plant. The cryogenic coil comprises a coil conductor for generating a magnetic field upon energization with electrical current, and refrigeration means disposed in heat conductive relation to the coil conductor for cooling to a low temperature. A substantial reduction in the power requirements for generating these magnetic fields is attained by scaling the field generating coil to large size and particular dimensions for a particular conductor, and operating the coil at a particular optimum temperature commensurate with minimum overall power requirements. (AEC)

Astrophysics and Cosmology

22401 ISOPHOTAL CONTOUR MAPS OF SUNSPOTS. R. J. Bray and R. E. Loughhead (C.S.I.R.O., Chippendale, New South Wales, Australia). Australian J. Phys., 15: 482-9(Dec. 1962).

Maps are presented showing the complex intensity distribution in the umbrae and penumbrae of two large spots. The umbral isophotes show several points of minimum intensity, in one of which the temperature is some 500°K below the average for the umbra. This extra-dark region, or core, is only a few seconds of arc in diameter and is located near one end of the umbra. The possible relation between the detailed intensity distribution and the detailed magnetic field distribution is discussed. In particular, it is suggested that the core represents the region of greatest field strength. On this basis a new model of the magnetic field configuration inside a sunspot umbra is proposed. (auth)

22402 DECAMETRIC RADIO EMISSION OF JUPITER. G. R. A. Ellis and P. M. McCulloch (Univ. of Tasmania, Australia). Nature, 198: 275(Apr. 20, 1963).

The cyclotron hypothesis of decametric radio emissions of Jupiter, the possible effects due to variations in the probability of occurrence, and changes in the mean intensity of the bursts with rotation were studied using observations of Jupiter at 4.8 Mc/s and 19 Mc/s during 1961 and 1962 made at Hobart. Three almost equal maxima were observed, two of which were consistent with the cyclotron hypothesis. Possible assumptions needed to explain the third maxima are proposed. (C.H.)

Cosmic Radiation

Refer also to abstracts 22070 and 22439.

22403 (AD-282243) THE RELATIVE ABUNDANCE OF NUCLEI HEAVIER THAN LITHIUM IN PRIMARY COSMIC RADIATION. K. Kristiansson, O. Mathiesen, and A. Stenman (Lund, Sweden. Univ.). June 1962. 38p.

Photometric measurements were made on 362 tracks of heavy primary particles ($Z > 3$), which were found in an emulsion stack exposed over Texas at 41° geomagnetic latitude. The measurements were corrected for different emulsion effects. The tracks were selected according to a track length criterion that states that the tracks to be accepted must be long enough to give a standard error in the determination of the charge of about 0.2 units of charge. The charge calibration was made by δ-ray counting, gap length measurements and break-up events. To the heavy part of the spectrum ($Z > 9$) 60 tracks from an earlier investigation were added. The observed spectrum was extrapolated to the top of the atmosphere. The following observations are made: the ratio $N_0(Z = 5)/N_0(Z > 5) = 0.18 \pm 0.04$; the relative amount of C, N, and O is $0.75 : 0.22 : 1.00$; the ratio $N_0(Z > 9)/N_0(6 \leq Z \leq 9) = 0.55 \pm 0.06$; the ratio $N_0(Z \geq 17)/N_0(10 \leq Z \leq 16) = 0.36 \pm 0.07$; in the region $10 \leq Z \leq 16$, an element with even charge is 8^{+4}_{-2} times more abundant than an element with odd charge; the number of particles in the interval $17 \leq Z \leq 21$ is appreciably smaller than the number of particles with $Z > 21$; and in the region $Z \geq 22$, chromium and iron are the dominating nuclei and show approximately the same abundance. 37 references. (auth)

22404 (AFCRL-62-379) CORPUSCULAR RADIATION MEASUREMENTS BY 1959 IOTA (EXPLORER VII) RECORDED AT KIRUNA GEOPHYSICAL OBSERVATORY. Scientific Report No. 3. Ludwik Liszka (Sweden. Kungliga Vetenskapsakademien. Geofysiska Observatoriet, Kiruna). Jan. 20, 1962. Contract AF61(514)-1314. 86p. (AD-282197)

Data obtained by means of two Geiger counters on Explorer VII were recorded at Kiruna Geophysical Observatory during some 80 transits of the satellite between February 6th and March 2nd, 1961. The radiation measurements were investigated with respect to the geomagnetic activity and to the geographical position of the satellite. Curves of recorded apparent counting-rates are included in the report. (auth)

22405 (AFCRL-62-441) AFCRL STUDIES OF THE NOVEMBER 1960 SOLAR-TERRESTRIAL EVENTS. J. Aarons and S. M. Silverman, eds. (Air Force Cambridge Research Labs., Laurence G. Hanscom Field, Bedford, Mass.). Apr. 1962. 162p. (AD-281948)

A conference on the November 1960 solar-terrestrial events was held at the Air Force Cambridge Research Laboratories, Hanscom Field, Bedford, Massachusetts, February 15 to 17, 1961. Data on solar and geophysical observations and their theoretical interpretations by the scientific staff at AFCRL are presented. The solar-terrestrial events are unique in that they provide information on solar particles of cosmic-ray energies and on geophysical and propagation effects of the cosmic-ray flares. 108 references. (auth)

22406 (TID-18600) COSMIC-RAY EXPOSURE HISTORY OF METEORITES FROM COSMOGENIC CHLORINE-

36. Parmatma S. Goel and Truman P. Kohman (Carnegie Inst. of Tech., Pittsburgh). [Nov. 1962]. Contract [AT(30-1)-844]. 25p.

Cl^{36} activities have been measured in 27 samples of 10 iron meteorites, giving for the first time information on the distribution of a cosmogenic radionuclide within meteorites. The activities range from 23 dpm/kg for one specimen of Aroos to 2.3 dpm/kg for one of Canyon Diablo, except for a specimen of Ider, in which ≤ 0.4 dpm/kg was present. The Cl^{36} data are compared with inert gas data in the same meteorites, particularly Sikhote Alin, Carbo, and Grant. Ar^{36}/Cl^{36} and He^3/Cl^{36} "exposure ages" vary considerably within each meteorite. The discrepancies are due to the fact that the concentration gradients are considerably greater for Cl^{36} than for the inert gases. The gradients are roughly in the same direction, and indicate a much steeper depth effect for the radionuclide than for the stable products. This indicates that space erosion was general and significant. The bulk of the stable products in a specimen accumulated when it was relatively deep and the gradients small, whereas the radioactive products were produced quite recently when it was relatively close to the surface and the gradients large. The indicated space erosion rate is about 0.02–0.10 cm My^{-1}. A consequence of such a high erosion rate is that, in order to produce the present concentrations of inert gases, the cosmic-ray flux must have been more intense in the remote than in the recent past. If the intensity has been decreasing exponentially as $F(t) = F_0 e^{-t/\tau}$, τ must be about 100–300 My. An analysis of published K^{40}/K^{41} ratios in iron meteorites supports these conclusions. 38 references. (auth)

22407 HIGH-ENERGY GAMMA-RAY ASTRONOMY. G. G. Fazio (Univ. of Rochester, N. Y. and Smithsonian Astrophysical Observatory, Cambridge, Mass.), C. J. Cook, and E. M. Hafner. IEEE (Inst. Elec. Electron. Engrs.) Trans. Nucl. Sci., NS-10: No. 2, 10-14(Apr. 1963).

The search for gamma radiation with energy greater than 50 Mev from extraterrestrial sources has resulted in some of the most interesting and most difficult balloon and space-craft experiments. The present status of this search is reviewed. The first attempt to detect this radiation from solar flares resulted in no increase of the counting rate above background intensity. An upper limit of 1.0×10^{-2} photons cm^{-2} sec^{-1} in the type 2 flare of March 13, 1962, and an upper limit of 1.2×10^{-2} photons cm^{-2} sec^{-1} in the type 3 flare of March 22, 1962, was determined for the gamma-ray flux. The upper limit to the flux from the quiet sun was 1.0×10^{-2} photons cm^{-2} sec^{-1}. These results represent a partial reduction of the data from the first Orbiting Solar Observatory. (auth)

22408 SOME PECULIARITIES IN THE DIURNAL VARIATION OF MAXIMUM IONIZATION DENSITY OF THE F2 LAYER. C. S. R. Rao (All India Radio, New Delhi, India). Nature, 198: 276-7(Apr. 20, 1963).

Analysis of data from 7 stations of the Indian Ionospheric Stations on the 75° E. meridian for the month of September showed two peculiarities in the diurnal variation of the critical frequency of the F_2 layer between periods of low and high sunspot activity. Results are compared with diurnal variation of density of the F_2 layer observed during September in previous years. Possible explanations of this anomaly are presented. (C.H.)

22409 A NEW METHOD OF RECORDING LARGE COSMIC-RAY AIR SHOWERS. C. B. A. McCusker and M. M. Winn (Univ. of Sydney). Nuovo Cimento (10), 28: 175-8(Apr. 1, 1963). (In English)

The difficulty of recording fast-timing information in a large air-shower array is discussed, and a possible solution to this problem is proposed. The time of passage of shower fronts at each detector station in the array is to be measured with respect to the time as given by a time-signal transmitter in or near the array. Details of the method are given. (auth)

22410 ENERGY SPECTRUM OF INDIVIDUAL γ-RAYS AT BALLOON ALTITUDE. F. Abraham, J. Kidd, M. Koshiba, R. Levi Setti, C. H. Tsao, and W. Wolter (Univ. of Chicago). Nuovo Cimento (10), 28: 221-3(Apr. 1, 1963). (In English)

The absolute intensity and the energy spectrum of γ rays of energies greater than 10^{12} ev were obtained from a study of the electromagnetic cascades in a stack of pure nuclear emulsion exposed at 106,000 feet. The experimental γ spectrum before and after detection probability corrections is displayed and compared with Kidd's results. Spectra above and below 10^{12} ev were normalized at this energy. (auth)

22411 THE MOMENTUM SPECTRUM OF COSMIC RAY MUONS AT AN ANGLE OF 80° TO THE ZENITH AT SEA LEVEL. F. Ashton and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 81: 593-603 (Apr. 1, 1963).

A magnetic spectrograph making use of deflection in a solid iron magnet was used to measure the differential momentum spectrum of cosmic ray muons at sea level for zenith angles close to 80° over the momentum range 1.5 to 40 Bev/c. The measured spectrum is close to that expected if all the muons come from pions. An analysis is made of the spectrum expected on the basis of muons being derived from charged kaons and conclusions are drawn about the rate of production of charged kaons under certain restrictive assumptions. (auth)

22412 THE SIZE SPECTRUM AND ZENITH ANGLE DISTRIBUTION OF AIR SHOWERS CONTAINING 10^5–10^6 PARTICLES. H. Coxell, P. S. Scull, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 81: 604-11(Apr. 1, 1963).

An array of flash-tubes was operated with air shower detectors to study the density spectrum and zenith angle distribution of showers. The density spectrum was measured with two triggering arrangements. For showers of median size of 2×10^5 particles the differential spectrum can be represented by a power law of exponent -2.61 ± 0.05 and for a median size of 8×10^5 particles the exponent is -3.3 ± 0.3. This result lends support to previous observations of an increase in slope of the size spectrum between 10^5 and 10^6 particles. The zenith angle distribution was measured and found to correspond to a shower attenuation length of 115 ± 14 g cm^{-2} for showers in the range $(1-10) \times 10^5$ particles. (auth)

22413 RADIATION BELTS. Brian J. O'Brien. Sci. Am., 208: No. 5, 84-96(May 1963).

A review of present knowledge of the Van Allen radiation belts is given with special reference to particles injected by nuclear explosions. The composition of the inner and outer belt and the effects of solar winds on them are included. Electron and proton flux in the magnetosphere for regions outside the two radiation belts are discussed. A possible mechanism for auroras is mentioned. (C.E.S.)

Elementary Particles and Radiations

22414 (AD-402106) A DYNAMICAL THEORY OF BARYONS. H. C. Corben (Space Technology Labs., Inc.,

Redondo Beach, Calif.). Dec. [1962]. Contract Nonr-3769(00). 34p. (STL-8665-6002-RU-000)

The simplest relativistic wave equations for a particle which in the classical limit possesses moments of inertia about more than one axis are Dirac and Kemmer-Duffin equations containing extra terms that permit these equations to describe a variety of spin states. The classical field theory of such wave equations is developed and the generalized Dirac equation for particles of spin $^1/_2$ and $^3/_2$ is examined in detail. It is found that with the choice of only one parameter, which merely determines the scale, this equation not only correctly describes the spin and charge states of the particles and resonances Ξ^-, Ξ^0, N, P, N**, Y_0**; it also yields their masses correct to better than 2%. In addition, with the same choice of this parameter, the theory has so far yielded the correct masses, to the same accuracy, for the resonances N***, Y_1**, Y_0***, N****, giving their spins as $^5/_2$, $^5/_2$, $^7/_2$ and $^9/_2$ respectively. The $\Xi^- - \Xi^0$ and N–P mass differences have the correct sign but are several times their observed values. Choice of one other parameter to give the correct N–P mass difference would lead to even better agreement with experiment for the other states, but would also lead to proton and neutron isobars lying 20 Mev above the ground state. (auth)

22415 (AEET/Anal./6) A HYDRODYNAMIC MODEL OF RADIOACTIVITY. S. Gangadharan and R. Krishnamoorthy Iyer (India. Atomic Energy Establishment, Trombay). 1963. 19p.

The rate of flow of water from a cylindrical reservoir through a capillary tube is exponential with respect to time. This principle is made use of in demonstrating the decay of a radionuclide, the growth of a daughter from a parent, attainment of radioactive equilibrium and other parent-daughter relations. Since the half life of the system can be fixed at will, such demonstrations can be performed in a short period of time. Further applications of this device are also suggested. (auth)

22416 (CEA-Bib-30) LA RETRODIFFUSION DES PARTICULES β. (β-Particle Back-Scattering). P. Manoukian (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1962. 61p.

Experimental studies made on β backscattering during the last fifteen years are compiled. The most important data from each work are presented in tables and graphs. Applications of backscattering are also discussed. (51 references). (auth)

22417 (CERN-63-8) THE PLACE OF ELEMENTARY PARTICLE RESEARCH IN THE DEVELOPMENT OF MODERN PHYSICS. V. F. Weisskopf (European Organization for Nuclear Research, Geneva). Mar. 26, 1963. 24p.

A simplified concept of the physics of elementary particles and their interactions, based on modern field theory, is proposed. Excited states of baryons are considered as different formations of a nuclear field surrounding the source (a baryon). The case of a field without a source is also considered for the electromagnetic situation and the analogous nuclear field. The present state of elementary particle physics is summarized. (D.C.W.)

22418 (ISS-62/7) RELAZIONI PRESENTATE AL CONGRESSINO DEI LABORATORI NAZIONALE DE FRASCATI, (7-9 FEBBRAIO 1962). Papers Presented at the Congress of the National Laboratories in Frascati (February 7-9, 1962). (Italy. Istituto Superiore di Sanità, Rome). Mar. 1, 1962. 67p.

Summaries of the papers presented by the Physics Laboratory of the Istituto Superiore di Sanita at the High Energy Physics Congress held in Frascati in February 1962 are compiled. The subjects discussed are measurements of single π^0 meson photoproduction and Compton effect on protons, heavy neutral meson photoproduction, π^- meson capture in complex nuclei, measurement of the lifetime of π^+ mesons on curved and straight paths, and preliminary results on the study and utilization of the "synchrotron light." (J.S.R.)

22419 (ISS-63/1) PROGRAMMA PER IL CALCOLO DELLE MASSE ASSOCIATE AL PROTONE DI RINCULO, NELLA REAZIONE: $\gamma + p \rightarrow p + X^0$ (CALCOLATORE ELETTRONICO IBM 610). (Program for Calculating the Masses Associated with a Recoil Proton in the Reaction $\gamma + p \rightarrow p + X^0$ (610 IBM Electronic Computer)). A. Cacciani (Italy. Istituto Superiore di Santià, Rome). Jan. 2, 1963. 19p.

A program for calculating the mass of a particle, X^0, associated with proton recoiling at a given angle and with a given kinetic energy is outlined. The particles are produced by a gamma quantum through the two body reaction $\gamma + p \rightarrow p + X^0$. Two examples are given. (auth)

22420 (JINR-D-1191) QUASIPOTENTIAL CHARACTER OF THE SCATTERING AMPLITUDE. A. A. Logunov, A. N. Tavkhelidze, I. T. Todorov, and O. A. Khrustalev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 9p.

It is shown that in order to describe the bound states in quantum field theory it is possible to construct a local potential that is a superposition of Yukawa potentials, with energy dependent intensities. (auth)

22421 (JINR-E-1210) DIAGRAM TECHNIQUE AND REGGE POLES. G. Domokos (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 8p.

A modified "isobar approximation" is proposed, where the "isobar" is described by means of a Regge pole. Rules are set up for the calculation of Feynman diagrams containing Regge poles. Most properties of usual diagrams (in particular, the recipe of calculating imaginary parts) remains valid for these generalized diagrams. (auth)

22422 (JINR-E-1227) ON HELICITY AMPLITUDES. Ya. A. Smorodinskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 9p.

A method of helicity amplitudes developed by Wick and Jacobi becomes quite elementary if formulated in the relativistic velocity space with Lobachevsky's metric. In this space the relativistic properties of the helicity amplitudes are rather simple. As an example the transformation of the spin amplitudes from one channel of the binary reaction to the other (the crossing transformation employed in quantum field theory) is considered. (auth)

22423 (JINR-P-1205) DISPERSIONNYE SOOTNOSHENIYA I SPEKTRAL'NYE PREDSTAVLENIYA V TEORII VOZMUSHCHENII. (Dispersion Relations and Spectral Representations in Perturbation Theory). I. T. Todorov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 113p.

The results of the investigation of the analytic properties of Feynman graphs are systematically set forth. Using the method of majorization of graphs, spectral representations for the vertex part and for the scattering amplitude of π mesons and nucleons are deduced. Dispersion relations were obtained for the partial wave amplitudes in nucleon-nucleon and pion-pion scattering from dispersion relations for fixed cos θ. Parametric equations for the

surface of proper singularities of an arbitrary graph in the complex space were also derived. 122 references. (auth)

22424 (JINR-P-1213) RASSEYANIE NEITRONOV NA DEITRONAKH PRI MALYKH ENERGIYAKH. (Low-Energy Neutron-Deuteron Scattering). V. N. Efimov (Joint Inst. for Nuclear Research Dubna, U.S.S.R. Lab. of Neutron Physics). 1963. 11p.

The S-scattering phases of neutrons on deuterons at low energies were calculated by using the variational method with account of the deuteron deformation. The nucleon interaction was assumed to be central, charge-invariant and to have a charge exchange character. The radial dependence of the potential of nuclear forces was chosen in the form of the Gaussian curve whose parameters are brought into agreement with the data on n-p interactions at low energies. In choosing the probe functions besides the deuteron deformation a possibility of forming a doublet state with a quasitriton radial dependence was taken into account. The obtained values of the quartet scattering length $a_4 = 5.8$ f and the doublet $a_2 = 0.9$ f are in good agreement with one of the two sets of the experimental values $a_4 = (6.38 + 0.06)$ f, $a_2 = (0.7 + 0.3)$ f, and the s-phases coincide satisfactorily with the values obtained by Christian and Gammel from the analysis of the angular distributions of scattering and brought into agreement with the above experimental values of the scattering lengths. 23 references. (auth)

22425 (JINR-P-1217) FAZOVYI ANALIZ UPRUGOGO (P-P)-RASSEYANIYA PRI 660 Mev S UCHETOM RELYATIVISTSKIKH EFFEKTOV. (Phase Shift Analysis of Elastic p-p Scattering at 660 Mev with Account of Relativistic Effects). R. Ya. Zul'karneev and I. N. Silin (Joint Inst. for Nuclear Research Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 14p.

A phase shift analysis of p-p scattering at 660 Mev was made by assuming that pions are produced at this energy from $^1D_2, ^3P_{0,1,2}$ states of the p-p system. The analysis was performed by taking into account relativistic spin effects. In the interval $\bar{x}^2 \leq x^2 \leq 2\bar{x}^2$ the unique solution was found. The magnitudes of the parameters characteristic of the scattering at this energy are given. They were calculated according to a most probable solution N1. (auth)

22426 (JINR-P-1221) FAZOVYI ANALIZ NUKLON-NUKLONNOGO RASSEYANIYA PRI ENERGII 660 Mev. (Phase Shift Analysis of Nucleon-Nucleon Scattering at 660 Mev). Yu. M. Kazarinov, V. S. Kiselev, and I. N. Silin (Joint Inst. for Nuclear Research Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 16p.

A combined phase shift analysis of n-p and p-p data was made. Four sets of phase shifts were found, which have almost the same probability by the χ^2 criterion $|\chi^2|/\overline{\chi^2} = 1.8$. 22 references. (auth)

22427 (LNF-62/99) ON THE DECAY OF THE η MESON. Note No. 169. H. Shimodaira (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Nov. 26, 1962. 12p.

The decay of the η meson is estimated by considering higher mass contribution beside the ρ and ω. It is shown that the branching ratio $P(\eta \to 2\gamma)/P(\eta \to \pi^+\pi^-\pi^0)$ comes out well while a little larger ratio for $P(\eta \to \pi^+\pi^-\gamma)/P(\eta \to 2\gamma)$ is obtained, although it may not be much in disagreement with present data. (auth)

22428 (LNF-63/16) THE DECAY MODES $\eta^0 \to \gamma + e^+ + e^-$ AND $\eta^0 \to \gamma + \mu^+ + \mu^-$. Note No. 188. E. Celeghini and R. Gatto (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Mar. 25, 1963. 4p.

The spectra and probabilities of $\eta^0 \to \gamma + e^+ + e^-$ and $\eta^0 \to \gamma + \mu^+ + \mu^-$ are calculated. It is assumed that η^0 is the eighth member of the unitary symmetry octet containing π and K. η^0 has the quantum numbers J = 0, P = –1, I = 0, and C = G = +1. The $\eta^0 \to 2\gamma$ amplitude is approximated by a subtraction term and the pole terms due to ρ^0 and ω^0. (C.E.S.)

22429 (LNF-63/19) NON PERTURBATIVE SOLUTION OF SMALL ANGLE SCATTERING PROBLEMS (MOLIERE'S APPROXIMATION). Note No. 191. C. Bernardini and C. Pellegrini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Apr. 8, 1963. 8p.

A simple procedure is used to derive Molière's expression for the cross section for small angle scattering of a particle by the potential due to an extended source. Based on the assumption that the Fourier transform (over space coordinates) of the potential falls to zero rapidly enough at large wave numbers, the procedure is more general; and the solution given is applicable for both long and short range potentials. (D.C.W.)

22430 (NP-12591(Pt.I)) QUELQUES PROBLÈMES LIÉS AUX MESONS π, PHOTONS-NUCLÉONS. 1re PARTIE. (Some Problems Associated With π Mesons, Photons, and Nucleons. Part I). Michel Gourdin (Paris. Université). [1960]. 63p.

[Presented at] Summer School of Theoretical Physics, Cargèse (Corsica), Session of July 1960, Number 2.

In the series of lectures presented at the Summer School of Theoretical Physics, the interactions of photons with π mesons and nucleons are discussed. The invariances, unitarity, and Mandelstam representations for $\gamma + \pi \to \pi + \pi$ and $\gamma + \pi \to \gamma + \pi$ are given. The Fredholm equation is also considered for the first reaction and the integral equations for the second. (J.S.R.)

22431 (NP-12591(Pt.II)) QUELQUES PROBLÈMES LIÉS AUX MÉSONS π, PHOTONS-NUCLÉONS. 2e PARTIE. (Some Problems Associated With π Mesons, Photons, and Nucleons. Part II). Michel Gourdin (Paris. Université). [1960]. 62p.

[Presented at] Summer School of Theoretical Physics, Cargèse (Corsica), Session of July 1960, Number 2.

In the second part of the lectures on the interactions of photons with π mesons and nucleons, the interaction $\gamma + N \to \pi + N$ is discussed with a consideration of the invariances, photoproduction, and Mandelstam representation. Seminars on the bipion model and application of the Mandelstam representation to problems connected with strange particle phenomena are also given. (J.S.R.)

22432 (NP-12610) PROBLÈMES LIÉS AUX NUCLÉONS ET ANTINUCLÉONS. (Problems Associated With Nucleons and Antinucleons). Maurice Lévy. ASPECTS OF THE THEORY OF WEAK INTERACTIONS. Jeremy Bernstein (Paris. Université). [1960]. 31p.

[Presented at] Summer school of Theoretical Physics, Cargèse (Corsica), Session of July 1960, Number 1.

The course presented at the Summer School of Theoretical physics on problems associated with nucleons and antinucleons is reproduced. The topics discussed in the section by Lévy are antinucleon phenomena, nucleon-nucleon potentials, nucleon-nucleon scattering studied by a method proceeding from the Mandelstam theory, and consideration on dephasing. In the lectures by Bernstein on weak interactions, it is recognized that some of the most inter-

esting aspects of weak interactions arise because the weakly interacting particles are also strongly interacting. A résumé of relativistic quantum field theory is then given. Beta decay theory is also considered. (J.S.R.)

22433 (NP-12661) LOW ENERGY X-RAY MASS ATTENUATION COEFFICIENTS FOR RADIATION 850 TO 3000 eV IN SELECTED ELEMENTS WITH Z = 6 TO Z = 18 (thesis). Peyton R. Wise, II (Johns Hopkins Univ., Baltimore). 1961. 29p.

The attenuation of x-rays with energies from 853 to 2991 ev by an aluminum film, and C_2H_4, N_2, O_2, Ne, and A gases was measured using a beryl crystal monochromator. Experiment led to the determination of mass attenuation coefficients with less than two percent probable error obtained by low kilovoltage operation of the x-ray tube and by flow proportional counter detection with pulse height discrimination. Some features of flow proportional counting using $He-A-CH_4$ gas are discussed. Also a comparison of this work with previous determinations of a few experimental values in this x-ray region are included. (auth)

22434 (NP-12727) MESSUNG DER TRANSVERSALEN POLARISATION EINES ELEKTRONENSTRAHLS MIT DEM MØLLER-DETEKTOR. (Measurement of Transverse Polarization of Electron Beams with the Mueller-Detector (thesis)). Klaus Tradowsky (Berlin. Technische Universitat). 1963. 60p.

Apparatus was developed for measurements of Mueller scattering and the polarization of electron beams with a Mueller detector. The electron-electron scattering was separated from other scattering processes by a magnetic energy separation of the electrons and a coincidence measuring process. Neither the electron-nucleus nor multiple scatterings were disturbed with 2000-Å-thick films. With the Mueller detector the polarization of a polarized electron beam was measured on a 1000-Å-thick gold foil with a scattering angle of 90° by means of Mott scattering. The polarization was calculated to be 0.14 ± 0.05. (M.C.G.)

22435 (NP-12730) ON THE ELASTIC SCATTERING OF PROTONS AND PIONS ON NUCLEONS WITH LARGE MOMENTUM TRANSFERS. Yu. Bayukov, N. G. Birger, G. A. Leksin, and D. A. Suchkov (Akademiya Nauk S.S.S.R. (Institut Teoreticheskoi i Eksperimental'noĭ Fiziki). 1962. 12p.

Momentum transfer as a function of energy was studied for pion-nucleon, nucleon-nucleon, and antiproton-proton scattering. An expression for the four-momentum transfer function was obtained from a cross section expression. Cross sections for the above interactions were studied as a function of incident energy; values obtained were used to evaluate the momentum function in a few intervals of four-momentum transfer. Results are graphically displayed. (D.C.W.)

22436 (ORNL-3440) RECURSION RELATIONS AND SIMPLIFIED EXPRESSIONS FOR THE 6-j SYMBOLS. C. D. Zerby (Oak Ridge National Lab., Tenn.). May 16, 1963. Contract W-7405-eng-26. 9p.

It is shown that the 144 symmetry properties of the 6-j symbols which were discovered by Regge can be displayed with a 4 × 4 array that is invariant to the ordering of three of the rows and all columns. The elements of the array are linear combinations of the quantum numbers. In addition, it is shown that a large set of three-term recursion relations exist. The recursion relations are used to deduce simplified expressions for the 6-j symbols in special cases. (auth)

22437 (SLAC-13) HEAVY MESONS AND EXCITED BARYONS. D. B. Lichtenberg (Stanford Univ., Calif. Stanford Linear Accelerator Center). Mar. 1963. Contract AT(04-3)-400. 98p.

Heavy meson and excited baryon states are examined with particular emphasis on using conservation laws to determine their quantum numbers. Tables of known and suspected baryons and mesons are given along with some information on them. Techniques for determining parity and spin of particles as well as the use of Dalitz plots to gain information on short-lived excited states are discussed. G-parity and selection rules for heavy meson decay are examined; and the isospin, parity, and spin of the ρ, ω, η, and K^* mesons are investigated. Investigation of the ξ and φ particles decaying by different modes in K-$\bar{K}$ systems are reviewed, and the ABC effect is treated. Evidence for other mesons is also included. Similarly, means for determining parities and spins of excited baryons are considered, and evidence for the existence of excited nucleon states is cited. Isospin, parity, and spin of several hyperons are also discussed. Evidence for the existence of other excited baryons and hyperons is included, and classification of baryons and mesons in a unitary symmetry scheme combined with Regge trajectories is explored. 103 references. (D.C.W.)

22438 NUCLEAR EMULSIONS EXPOSED IN A PULSED MAGNETIC FIELD TO A BEAM OF 13 Gev PROTONS. J. Catalá, E. Villar, G. Pardo, A. Ruiz, and R. Llosá (Facultad de Ciencias, Valencia). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 261-6(Sept.-Oct. 1962). (In Spanish)

The preliminary results obtained during the study of photographic plates exposed to a beam of high energy protons in a pulsed magnetic field are presented. The beam characteristics were analyzed, magnetic curvature measurements were made, and the first results with poor statistics about the mean free path for protons in emulsion are given. (auth)

22439 TWO POSSIBLE MODELS OF HYPERFRAGMENTS WITH CHARGE Z > 6. Maria Grazia Barbetta, Lanfranca Cavallini, Carlo Depietri (Universitâ, Modena, Italy). Atti Seminar. Mat. Fis. Univ. Modena, 11: 110-15(1961-62). (In Italian)

Two events observed in nuclear emulsions exposed to cosmic radiations were studied. They were interpreted as decays of hyperfragments with very high charges. (tr-auth)

22440 A STRONG INTERACTION SCHEME BASED ON THE B_3 GROUP. Guy Loupias, Michel Sirugue, and Jean-Claude Trotin. Compt. Rend., 256: 2311-13(Mar. 11, 1963). (In French)

The particles decaying by strong interactions were classified by representations of the invariance group of strong interactions. As the conservation of the baryon number was assured individually by reference to a one-parameter invariance group, the total invariance group would be the direct product of this group by the simple B_3 Lie group. The representations of the B_3 Lie group are reducible, with the baryons considered as meson spinors. (J.S.R.)

22441 EFFECT OF THE MEAN FREE ELECTRON PATH ON THE RECOMBINATION TIME OF QUASI-PARTICLES IN A SUPERCONDUCTOR. Daniel Saint-James (Centre d'Études Nucléaires, Saclay, France). Compt. Rend., 256: 2353-6(Mar. 11, 1963). (In French)

The recombination time of quasi-particles excited above the energy jump is proportional to the mean free path for

low values of quasi-particles (thin sample or high impurity concentration). The time found is much shorter than that obtained in pure metals. (tr-auth)

22442 THE EIGEN-ENERGIES OF QUANTUM STATES OF THE RELATIVISTIC ROTATOR. Francis Halbwachs. Compt. Rend., 256: 2547-9(Mar. 18, 1963). (In French)

Within the framework of the theory of the relativistic rotator, an invariant interaction Hamiltonian is written under the "internal" group that is at the basis of the theory. This Hamiltonian furnishes the ensemble of strong interactions observed between elementary particles and new particles presumed unstable. A classical calculation of eigen-energies made on this Hamiltonian gives, between the masses of the four known baryons, a relation that experience has exactly verified. (tr-auth)

22443 NONELASTIC PROTON-NUCLEON INTERACTIONS AT THE 9 Bev ENERGY LEVEL. N. P. Bogachev, E. L. Grigor'ev, and Yu. P. Merekov (Joint Inst. for Nuclear Research, Dubna, USSR). Dokl. Akad. Nauk SSSR, 148: 793-5(Feb. 1, 1963). (In Russian)

Studies carried out with an emulsion chamber irradiated with 9-Bev protons indicated that 760 events were attributable to nonelastic proton-nucleon scattering type interactions, including 492 (p-p) and 268 (p-n) events. Multiple scattering and ionization density measurements were made for identifying the secondary charged particles. The average number of the charged π-mesons in the (p-p) events was found to be 2.36 ± 0.14; in the (p-n) events the upper limit was estimated at 1.76 ± 0.09. The experimental data on secondary protons did not agree with the statistics of the multiple generation theory; the number of high-energy protons was higher than predicted. Calculations based on the assumption of peripheral collisions of the nucleons with the exchange of a virtual meson at 1 Bev agreed well with the experimental results on the energy distribution of recoil protons, the angular distribution of charged π-mesons, and the asymmetry of the angular distribution of secondary particles in (p-n) collisions. The one-meson exchange model was satisfactory only for characterizing the interaction at a small number of generated particles. (TTT)

22444 INVESTIGATION OF THE NATURE OF PARTICLE GENERATION IN INELASTIC PION-NUCLEON INTERACTIONS. A. Kh. Vinitskiĭ, I. G. Golyak, V. I. Rus'kin, and Zh. S. Takibaev (Inst. of Nuclear Physics, Kazakh Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 148: 796-8(Feb. 1, 1963). (In Russian)

Generation of pions, strange particles, and new, rapidly decaying systems by the inelastic interaction of 7-Bev particles with the nucleons of the nuclear emulsion was investigated by exposing the emulsions to the pion beam of the Dubna synchrophasotron. From the 2000 recorded events 200 pion-nucleon events were selected on the basis of the previously established criteria. In these cases 323 particles were identified as pions, 19 as K-mesons, and 45 as protons. Comparison of the proton pulses obtained with the theoretically most probable range showed that the values did not coincide. The maxima observed were due probably either to nonpolarized processes involving large-scale proton pulse transfers or to a polarization phenomenon of a triple pion resonance system. (TTT)

22445 INTEGRAL REPRESENTATION OF THE VERTEX PORTION IN THE PERTURBATION THEORY. I-ch'ên Liu and I. T. Todorov (Joint Inst. for Nuclear Research, USSR). Dokl. Akad. Nauk SSSR, 148: 806-9(Feb. 1, 1963). (In Russian)

On the basis of N. Nakanishi's studies (Suppl. Progr. Theoret. Phys. Rev. No. 18, 1, 1961) an attempt was made to derive an integral presentation of a diagram selecting the analytical properties of the vertex portion. The usual single-dimensional dispersion relationships of the perturbation theory were derived from the data obtained from the spectral representation of the vertex portion. Diagrams referring to strongly interacting particles were considered, in particular the vertex portion of nucleon–photon systems. Starting from a previous study (Zhur. Eksptl' i Teoret. Fiz., 42: 1285, 1962) an integral representation of the amplitude of nucleon-nucleon scattering is derived. (TTT)

22446 TCP INVARIANCE OF THE SCATTERING MATRIX AND INTERPOLATED FIELDS. Res Jost (Eidgenossische Technische Hochschule, Zurich). Helv. Phys. Acta, 36: 77-82(1963). (In German)

Using LSZ interpolation procedure it is shown that a TCP-invariant S-matrix can be interpolated by weakly local fields. Recent papers by Henry P. Stapp are discussed. (auth)

22447 REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVE AT THE BOUNDARY BETWEEN ISOTROPIC AND OPTICALLY ACTIVE MEDIA. O. S. Mergelyan (Physico-Technical Lab. of the Central Research Inst., Academy of Sciences, Armenian SSR and Lebedev Inst. of Physics, Academy of Sciences, USSR). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk, 15: 75-82(1962). (In Russian)

Electromagnetic phenomena appearing with plane electromagnetic wave incidence at the boundary, between two media, one of which is optically active, was investigated. Polarization of refracted and reflected waves was studied and Frenel formulas were developed. (R.V.J.)

22448 RADIATION OF A CHARGE PASSING PARALLEL TO THE INTERFACE OF ISOTROPIC AND OPTICALLY ACTIVE MEDIA. O. S. Mergelyan. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk, 16: 111-17(1963). (In Russian)

Radiation by a charge passing through an isotropic medium over an optically active medium and generating right and left polarization was investigated. Formulas were derived for the energy flow and fields in the optically active medium. (R.V.J.)

22449 SCATTERING, WEAK DECAYS, AND FINAL-STATE INTERACTIONS IN MODEL THEORIES IN A DRESSED-PARTICLE PICTURE. Kurt Haller (New York Univ., New York). J. Math. Phys. (N. Y.), 4: 323-31(Mar. 1963).

Elastic and inelastic collisions in the Lee model are treated in a dressed-particle picture. The procedure by which the renormalization constant Z disappears from the integral equations for the transition matrix is studied in detail. A new procedure is given for obtaining the exact transition matrix for $N - \theta$ scattering. A hypothetical fermion B is introduced and the decays $B \rightarrow N + \theta$, $B \rightarrow V + \theta$, as well as the decay in the Goldberger-Treiman model are studied in the dressed-particle picture. The iterative expansion of the $B \rightarrow V + \theta$ decay amplitude is obtained and is shown to agree with the renormalized power series for this decay, though such is not the case for $B \rightarrow N + \theta$ decay, or the decay in the Goldberger-Treiman model. It is shown that in the final-state interaction of $B \rightarrow V + \theta$ decay, there are cancellation effects between one and two-meson contributions, that are crucial in avoiding divergences. (auth)

22450 APPROXIMATE SOLUTION OF A NONLINEAR FIELD EQUATION. D. D. Betts, H. Schiff, and W. B. Strickfaden (Univ. of Alberta, Edmonton). J. Math. Phys. (N. Y.), 4: 334-8(Mar. 1963).

Variational principles for obtaining the eigensolutions ψ_i

of the equation $\nabla^2\psi - \psi + \psi^3 = 0$ are developed. Variational solutions to the first two spherically symmetric eigenstates are obtained. Variational solutions of odd parity are also obtained. (auth)

22451 PARTIAL WAVE ANALYSIS OF THE SCATTERING OF CHARGED SPINLESS PARTICLES. J. H. Hetherington (Carnegie Inst. of Tech., Pittsburgh). J. Math. Phys. (N. Y.), 4: 357-8(Mar. 1963).

The partial wave series for a relativistic charged spinless particle is not uniformly convergent and is difficult to evaluate numerically in the forward direction. The singularity in the scattering amplitude at the forward direction that leads to this nonuniform convergence is separated and given explicitly in a closed form so that the partial wave series may be accurately evaluated numerically. (auth)

22452 REGGE POLES AND BRANCH CUTS FOR POTENTIAL SCATTERING. J. Challifour and R. J. Eden (Cambridge Univ., Eng.). J. Math. Phys. (N. Y.), 4: 359-71(Mar. 1963).

The analytic properties of partial wave amplitudes are studied for complex energy and angular momentum. The properties of the wavefunctions are first obtained by standard methods in the theory of differential equations for general classes of potentials, and the effects of the dominant singular term in the potential near the origin are investigated. These include the appearance of branch cuts in the angular-momentum variable for potentials that are singular like z^{-2}, and the location of Regge poles for more singular potentials. The trajectories of Regge poles are also studied with particular reference to their behavior in the angular-momentum plane as the energy tends to infinity. An example is given of a singular potential in which the trajectories move to infinity in a complex direction, contrary to the normal behavior for which they tend to negative integers. The real sections of Regge surfaces are also briefly discussed. (auth)

22453 POTENTIAL SCATTERING. Johan G. Belinfante and Burhan C. Unal (California Inst. of Tech., Pasadena). J. Math. Phys. (N. Y.), 4: 372-87(Mar. 1963).

The potential-scattering model is discussed from the point of view of analyticity properties of the scattering amplitude. Dynamical schemes based on the Mandelstam representation and the use of Regge poles are reviewed. Consequences for strong interaction physics are also briefly reviewed. (auth)

22454 NEW APPROACH TO LOW-ENERGY POTENTIAL SCATTERING. Roger F. Dashen (Sandia Corp., Albuquerque, N. Mex.). J. Math. Phys. (N. Y.), 4: 388-91 (Mar. 1963). (TID-16864)

The problem of low-energy potential scattering is reformulated in a manner suggested by the invariant imbedding techniques of transport theory. The differential equations thus obtained have several conceptual and computational advantages over the Schrödinger equation. Some new bounds and approximations are derived and a rigorous investigation of the Born approximation is carried out. (auth)

22455 SOME PROPERTIES OF THE REDUCED DENSITY MATRIX. C. N. Yang (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. (N. Y.), 4: 418-19(Mar. 1963).

Two conjectures concerning the properties of the reduced density matrix of an N-particle system of fermions or bosons are proven. A further remark is made concerning the largest eigenvalue of the reduced density matrices. (auth)

22456 NOTE ON THE RICCATI EQUATION. Francesco Calogero (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 4: 427-30(Mar. 1963).

A simple modification of a method is proposed, which under certain circumstances produces both upper and lower bounds for the solution of the Riccati equation. An application to scattering theory is suggested. (auth)

22457 NUCLEAR ACTIVITY AND DOSE. M. Pollermann. Kerntechnik, 5: 81-5(Feb. 1963). (In German)

The various possible actions of radiation are discussed briefly. A comparison is given of MKSA (meter-kg-sec-amp), photometric, and radiological units, and an example is given of the calculation of particle flux, radiation strength, and energy current density. The ion dose, absorbed dose, and relative-biological-effectiveness dose are discussed. Finally, the calculation of dose constants is considered. (D.L.C.)

22458 CIRCULAR POLARIZATION OF BREMSSTRAHLUNG PRODUCED IN HIGH-ENERGY COLLISIONS OF ELECTRONS WITH POLARIZED PROTONS. S. Sarkar (Indian Assn. for the Cultivation of Science, Calcutta). Nuovo Cimento (10), 28: 1-6(Apr. 1, 1963). (In English)

The circular polarization of bremsstrahlung emitted in the high-energy collision of an unpolarized electron with a proton that is initially polarized in an arbitrary direction is calculated. The effect of the anomalous magnetic moment and the recoil of the proton were taken into account, but the matrix element for the bremsstrahlung of the proton was neglected. Therefore, the formula is valid when the angle between the directions of the electron and the photon is of the order of mc^2/E (m and E being the mass and energy of the electron, respectively). (auth)

22459 MEASUREMENTS OF THE FORM FACTORS OF THE PHOTON AT MOMENTUM TRANSFERS $q^2 \leq 2$ FERMI^{-2}. B. Dudelzak, G. Sauvage, and P. Lehmann (Ecole Normale Supérieure, Orsay, France). Nuovo Cimento (10), 28: 18-24(Apr. 1, 1963). (In English)

To obtain precise experimental values of the Dirac form factor F_1 and the Pauli form factor F_2 at various momentum transfers q, the effective cross sections for electron scattering by protons for $q^2 = 0.30$, 0.49, 1.00, and 2.00 fermi^{-2} were measured. For the first two values a forward scattering angle of 60° was used, and F_1 was derived. Forward and backward angles were used for the last two values, and F_1 and F_2 were derived separately. (auth)

22460 COMPLEX ANGULAR MOMENTUM AND DOMAIN OF HOLOMORPHY. S. Okubo (Univ. of Rochester, N. Y.). Nuovo Cimento (10), 28: 47-55(Apr. 1, 1963). (In English)

An analyticity domain of the scattering amplitude A(l, s), which can be obtained by the use of the Mandelstam representation, is proved to be the domain of holomorphy, under certain conditions, of an analytic function of the complex angular momentum and of the complex energy variable s. The boundary of the analyticity domain is characterized by a sub-harmonic function of s. (auth)

22461 R-INVARIANCES OF STRONG AND WEAK INTERACTIONS. S. Okubo and R. E. Marshak (Univ. of Rochester, N. Y.). Nuovo Cimento (10), 28: 56-65(Apr. 1, 1963). (NYO-10248). (In English)

Three alternative formulations of invariance under hypercharge (R) conjugation are considered. Some consequences of the three forms of R-invariance are presented for weak interactions (both leptonic and nonleptonic) as well as for strong and electromagnetic interactions. Existing experimental data disfavor the standard form but are con-

sistent with the other two forms of R-invariance. Further experimental tests are needed to confirm the value of the new symmetry principle. (auth)

22462 ANALYTIC CONTINUATION AND ASYMPTOTIC BEHAVIOR IN ANGULAR MOMENTUM OF THE SCATTERING MATRIX IN POTENTIAL SCATTERING. F. Calogero (Princeton Univ., N. J.). Nuovo Cimento (10), 28: 66-77 (Apr. 1, 1963). (In English)

A simple proof is given of the fact that the scattering amplitude is a meromorphic function of angular momentum (for Re $l \leq -1/2$) and that it vanishes as $l \to \infty$ along any direction such that Re $l \to \infty$. (auth)

22463 SPURIOUS NATURE OF ULTRAVIOLET DIVERGENCES. A. Peres (Syracuse Univ., N. Y.). Nuovo Cimento (10), 28: 78-89(Apr. 1, 1963). (In English)

Removal of ultraviolet divergences from Feynman diagrams by first differentiating them with respect to their external momenta, then integrating with respect to the internal momenta, and finally integrating back with respect to the external momenta is shown possible. The last (indefinite) integrals involve arbitrary integration constants, which have to be fixed by further prescriptions, e.g., by requiring that there should be neither mass nor charge renormalization. The whole procedure is consistent with the requirements of covariance, unitarity, and causality, so that the ultraviolet divergences should be considered as entirely spurious. The results obtained by the present method are identical to those of renormalized quantum field theory, whenever renormalization is possible, but are reached here with less computational labor. Moreover, this method can also be applied, with the same ease, to nonrenormalizable interactions. Finally, the present method displays very clearly the arbitrariness involved at each stage of the perturbation procedure, which is quite parallel to the semi-phenomenological approach of dispersion theory. (auth)

22464 FORM FACTORS OF K_{13} DECAY AND KAON PRODUCTION BY HIGH-ENERGY NEUTRINOS. A. Fujii (Laboratori Nazionali, Frascati, Italy) and E. Celeghini. Nuovo Cimento (10), 28: 90-8(Apr. 1, 1963). (In English)

The cross-section of the kaon-production reaction by high energy neutrinos, $\nu + p \to p + l^- + K^+$, is computed in the peripheral approximation. Numerical estimates are made with specific form factors derived from the dispersion theory. The cross-section depends on such a dynamical model, hence it can serve as a criterion of the model. (auth)

22465 AMPLITUDES AND CROSSING RELATIONS IN ISOSPIN. A. O. Barut and B. C. Unal (Univ. of Colorado, Boulder). Nuovo Cimento (10), 28: 112-17(Apr. 1, 1963). (In English)

A systematic group-theoretical method is used to determine the isotopic spin amplitudes and crossing relations for processes involving particles with arbitrary isotopic spins. For two-body reactions, the scalar amplitudes and the crossing matrices are explicitly given up to $I = 3/2$. (auth)

22466 ELASTIC SCATTERING OF 7 Gev/c π^--MESONS ON PROTONS. T. Hofmokl (Univ. of Warsaw), A. Wroblewski, A. Filipkowski, et al. Nuovo Cimento (10), 28: 118-22 (Apr. 1, 1963). (In English)

The differential cross-section for the elastic scattering of 7 Bev/c pions on protons was investigated in a 24-liter propane bubble chamber. 508 elastic scatterings of π^- mesons on free protons were selected from two-prong events, and the differential cross-section was measured for cos $\theta_{cms} < 0.995$. By making use of the optical theorem to account for the forward scattering the total elastic cross-section was estimated to be (5.13) mb. The shape of the differential cross section is compared with the theoretical predictions of Domokos. (auth)

22467 POLES AND THRESHOLDS AND UNSTABLE PARTICLES. P. V. Landshoff (St. John's Coll., Cambridge, Eng.). Nuovo Cimento (10), 28: 123-31(Apr. 1, 1963). (In English)

Consequences of assuming that transition amplitudes display some analyticity in the coupling constants are investigated. This permits demonstration of the existence of singularities associated with unstable and virtual particles, similar to those required by unitarity for stable particles. It is simple to determine on which Riemann sheets lie the unstable and virtual particle singularities, and the stable particle singularities can also be shown to be absent from certain sheets. (auth)

22468 LEPTON CONSERVATION LAWS AND THE EXISTENCE OF TWO NEUTRINOS. P. K. Kabir (Carnegie Inst. of Tech., Pittsburgh). Nuovo Cimento (10), 28: 165-74(Apr. 1, 1963). (In English)

The existence of four independent neutrino states is related to the two conservation laws for leptons. The first is the usual law of lepton conservation, associated with gage transformations of the fields, while the second is derived from the γ_5 gage transformations of the neutrino field. The experimental basis of these laws is discussed. (auth)

22469 THE Λ^0-DECAY ASYMMETRY PARAMETER AND THE K-Λ PARITY. L. Gray (Syracuse Univ., N. Y.), E. Harth, J. Leitner, et al. Nuovo Cimento (10), 28: 179-83(Apr. 1, 1963). (In English)

Both the sign and magnitude of the asymmetry parameter α in $\Lambda \to p + \pi^-$ decay were determined by means of an investigation of the Λ-decay proton scattering angle distribution in liquid helium. The best value of α is 0.66 ± 0.20. The significance of the result in connection with the determination of the relative K-Λ parity is also discussed. (auth)

22470 INTERNAL DEGREES AND MASS QUANTIZATION FOR BARYONS AND RESONANCES. T. Takabayasi (Univ. of Nagoya, Japan). Nuovo Cimento (10), 28: 184-90 (Apr. 1, 1963). (In English)

Vector radii apart from the angular momentum vector t are introduced into isospace, thereby permitting treatment of a system with structure in isospace. This also leads to unification of baryons on the foundations of internal dynamics, and the unified wave equation obtained for baryons permits transition to the corresponding field theory which is briefly discussed along with interactions. (D.C.W.)

22471 ENERGY-DEPENDENCE OF PION ASYMMETRY IN ANTINUCLEON-NUCLEON ANNIHILATION. II. EXTENSION OF THE MODEL TO ANOTHER PROCESS AND A RE-EXAMINATION OF SOME PREVIOUS RESULTS. A. Stajano (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 28: 197-201 (Apr. 1, 1963). (In English)

Previous calculations for obtaining the asymmetry in angular distributions of pions produced in the antiproton annihilation reaction $\bar{p} + p \to \pi^+ + \pi^+ + \pi^- + \pi^-$ from a dynamical extension of Koba and Takeda's model are extended to the more prevalent process $\bar{p} + p \to \pi^+ + \pi^+ + \pi^- + \pi^- + \pi^0$. A mistake noted in the previous work in calculations of the relative weights of the various states of a system consisting of a bare nucleon plus two and plus three pions is corrected. (D.C.W.)

22472 A NEW APPROACH TO THE THEORY OF BARYONS. H. C. Corben (Space Technology Labs., Los

Angeles). Nuovo Cimento (10), 28: 202-5(Apr. 1, 1963). (In English)

Success of a generalized Dirac equation that contains an extra term and describes particles with spins other than ½ is discussed, and conditions for which the equation describes various particles are examined. An expression for the rest energy is derived and is noted to predict the spins and approximate the energies of the resonances Y_0^{**}, Y_1^{**}, at 2980 and 3300 $M_e C^2$. The formula also indicates further resonances with spins 11/2, 13/2, etc. at intervals of 160 Mev. (D.C.W.)

22473 REMARKS ON LOW'S MODEL OF ELEMENTARY AND COMPOSITE PARTICLES. Ching-hung Woo and R. W. Lardner (Columbia Univ., New York). Nuovo Cimento (10), 28: 210-14(Apr. 1, 1963). (In English)

Aspects of Low's model of composite and elementary particles are examined since the equivalence of two of his alternatives produces a case in which the bootstrap requirements are met, but not all arbitrary parameters are eliminated. Use of Levinson's theorem to distinguish between composite and elementary particles is also discussed. (D.C.W.)

22474 $K\bar{K}$-RESONANT STATE AND $\pi^- + p \rightarrow K + \bar{K} + \Lambda$ REACTION. S. Minami and P. L. Okhuysen (Louisiana State Univ., Baton Rouge). Nuovo Cimento (10), 28: 215-18(Apr. 1, 1963). (In English)

The $\pi^- + p \rightarrow K + \bar{K} + \Lambda$ reaction is studied under the assumption that there is a resonant state (Z-particle) in the $K\text{-}\bar{K}$ system. A bubble approximation is used to express the width of the Z-particle in terms of the π and K coupling constants. The one-pion-exchange model is used to estimate the cross section for the $\pi^- + p \rightarrow Z + n$ reaction, and an estimate is obtained for the $\pi^- + p \rightarrow K^+ + K^- + n$ reaction cross section. Evidence for the existence of other resonant states is also discussed. (D.C.W.)

22475 INTERMEDIATE SCATTERING FUNCTION IN SLOW NEUTRON SCATTERING. A. Rahman (Argonne National Lab., Ill.). Phys. Rev., 130: 1334-6(May 15, 1963). (TID-18371; UAC-7179)

The conditions under which the so-called intermediate scattering function occurring in the theory of slow neutron scattering and in the theory of the Mössbauer effect can be written in the form $\exp[-\kappa^2\gamma(t)]$ have been explicitly stated; the intermediate scattering function is then factorizable into two parts; the part referred to in the paper as the displacement part gives on Fourier transformation a real space-time function which, quite unambiguously, has the meaning usually attributed to the Van Hove $G_s(x,t)$ function; the other part arises out of the nucleus recoiling against the neutron. It is shown that for systems in thermal equilibrium, the recoil part can be expressed in terms of the displacement part. This relation enables one to take care of the recoil part in case a classical approximation is made for the dynamics of the scattering system. (auth)

22476 POSITRON ANNIHILATION IN LIQUID AND SOLID MERCURY. D. R. Gustafson, A. R. Mackintosh, and D. J. Zaffarano (Ames Lab., Ames, Iowa). Phys. Rev., 130: 1455-9(May 15, 1963). (IS-582)

Results are presented of a study of the angular correlation of photons from the annihilation of positrons with electrons in solid and liquid mercury. The angular distribution of photon coincidences can be separated into contributions arising from annihilations with the ionic-core electrons and with the conduction electrons. The angular variation of the former does not appear to change at the solid-liquid transition, but the distribution for the conduction electrons is considerably modified. The plot of the number of coincidences against angle for the conduction electrons in the solid can be fitted very well by a parabola corresponding to two free electrons per atom, which indicates that the Fermi surface in extended k space does not depart very significantly from a sphere. The relative number of annihilations from the conduction electrons in the liquid is considerably greater and the distribution departs from the free electron parabola at large angles. These effects are interpreted in terms of the distortion of the wave functions and the broadening of the electronic energy levels by the disorder in the liquid. It is concluded that the uncertainty in the wave vector of an electron at the Fermi surface in the liquid is about 20% of the Fermi wave vector. (auth)

22477 LOW-ENERGY PROCESS $\gamma + p \rightarrow K^+ + \Sigma^0$. T. K. Kuo (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 130: 1537-40(May 15, 1963).

The reaction $\gamma + p \rightarrow \Sigma^0 + K^+$ is discussed using the model developed in a previous paper. For odd-KΣ parity the differential cross section can be accounted for by the one-nucleon pole term and the K and K* exchange terms. With this model it is very difficult to fit the data for even-KΣ parity. The coupling constant found for odd-KΣ parity is $g_{\Sigma NK}^2/4\pi \approx 4.5$, very close to the value $g_{\Lambda NK}^2/4\pi \approx 4.0$ found in the previous paper. (auth)

22478 STATISTICAL ANALYSIS OF ELECTRON-PROTON SCATTERING. M. W. Kirson and J. S. Levinger (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 130: 1549-52 (May 15, 1963).

A statistical analysis of Stanford measurements of electron-proton scattering was made. The Rosenbluth formula was found to be valid within the experimental errors in the range $7 \leq q^2 \leq 25F^{-2}$, and in the range of angles covered. The form factors G_E, G_M and F_1, F_2, their errors, and correlated errors were evaluated. Values for the form factors are in reasonable agreement with the analyses of Hofstadter and of Richard Wilson. The errors in G_M are particularly small; the errors in F_1, F_2, and G_E are of similar magnitude. The coefficient of correlation between the errors of the form factors F_1 and F_2 is large and negative (–84% to –99%); the coefficient of correlation between the errors of G_E and G_M is almost as large and negative (–74% to –99%). G_E is about 40% larger than $G_M/2.79$ for $16.5 \leq q^2 \leq 25F^{-2}$; the ratio of G_E to $G_M/2.79$ is about two standard deviations from unity in this range of q^2. (auth)

22479 p-p HIGHER PARTIAL WAVES AND THE 3-MESON MODEL. William Ramsay (Univ. of California, San Diego). Phys. Rev., 130: 1552-4(May 15, 1963).

The pion, the ρ-ω vector pair, and a scalar 2π resonance are taken to explain the long-range nuclear forces. The calculated values are fitted to p-p phase-shift solutions for various values of the unknown mass and coupling constants. (auth)

22480 UPPER LIMIT FOR THE NONLEPTONIC $\Delta S = 2$ DECAY MODE OF Ξ^-. Massimiliano Ferro-Luzzi, Margaret H. Alston, Arthur H. Rosenfeld, and Stanley G. Wojcicki (Univ. of California, Berkeley). Phys. Rev., 130: 1568-70(May 15, 1963). (UCRL-10547)

No example of a Ξ^- decay into $n + \pi^-$ was found in a sample of 200 normal Ξ^- decays into $\Lambda + \pi^-$. (auth)

22481 ISOTOPIC SPIN OF EXCHANGED SYSTEMS. Leslie L. Foldy (Case Inst. of Tech., Cleveland) and Ronald F. Peierls. Phys. Rev., 130: 1585-9(May 15, 1963).

It is demonstrated that any scattering amplitude can formally be expressed as a sum of terms each corre-

sponding to the exchange of a particular isotopic spin without requiring the concept of crossing. Employing only the optical theorem and invariance under isotopic spin rotations the following theorem is proved: The contribution to the imaginary part of the forward scattering amplitude arising from the exchange of zero isotopic spin cannot be arbitrarily small compared to contributions from the exchange of any other isotopic spin or spins. From the same argument follows a second theorem: If the total cross section for two particles is independent of their isotopic spin state, then only the exchange of isotopic spin zero contributes to the imaginary part of the forward scattering amplitude. In combination with the hypothesis that high-energy scattering is dominated by the exchange of a single Regge pole, it follows that the "Pomeranchuk" pole must have isotopic spin zero. The relation to the Pomeranchuk-Okun' rule is discussed. (auth)

22482 EXACT ANALYSIS OF AN INTERACTING BOSE GAS. I. THE GENERAL SOLUTION AND THE GROUND STATE. Elliott H. Lieb and Werner Liniger (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 130: 1605-16(May 15, 1963).

A gas of one-dimensional Bose particles interacting via a repulsive delta function potential was solved exactly. All the eigenfunctions can be found explicitly and the energies are given by the solutions of a transcendental equation. The problem has one nontrivial coupling constant, γ. When γ is small, Bogoliubov's perturbation theory is seen to be valid. The ground-state energy as a function of γ is calculated explicitly and is shown to be analytic for all γ, except $\gamma = 0$. (auth)

22483 EXACT ANALYSIS OF AN INTERACTING BOSE GAS. II. THE EXCITATION SPECTRUM. Elliott H. Lieb (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 130: 1616-24(May 15, 1963).

The analysis of the one-dimensional gas of Bose particles interacting via a repulsive delta function potential is continued by considering the excitation spectrum. Among other things it is shown that: the elementary excitations are most naturally thought of as a double spectrum, not a single one; the velocity of sound derived from the macroscopic compressibility is shown to agree with the velocity of sound derived from microscopic considerations, i.e., from the phonon spectrum. A distinction between elementary excitations and quasiparticles is introduced, on the basis of which some heuristic reasons are given for expecting the double spectrum to be a general feature, even in three dimensions, and not an exception. (auth)

22484 ELECTRON CAPTURE FROM ATOMIC NITROGEN AND OXYGEN BY PROTONS. [PART] I. Robert A. Mapleton (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Rev., 130: 1829-38(June 1, 1963).

The BK approximation (Born approximation using only the proton-active electron interaction, ne) is used to derive the cross sections for p-orbital capture from atomic nitrogen and atomic oxygen by protons. Russell-Saunders (LS) coupling is assumed for the description of the atoms and ions, and only terms of the ground configurations are considered. Cross sections are derived for the set of processes for which the multiplicity is conserved between the initial state, $H^+ + A[p^n(LS)]$, and the final state, $H(^2S) + A^+[p^{n-1}(L'S')]$. Approximate cross sections for the inverse processes are expressed in terms of the cross sections for the corresponding direct processes. Furthermore, it is shown that all these cross sections are approximately related to one another for each atom. From this same analysis it is found that the cross sections for the direct processes are proportional to each of the following quantities: $(2L + 1)^{-1}$; n, the number of p orbitals in the target atom; the square of a coefficient of fractional parentage; a sum of squares of vector coupling coefficients. Detailed numerical calculations are presented for the following processes: $H^+ + N(^4S) \rightarrow H(1s) + N^+(^3P)$; $H^+ + O(^3P) \rightarrow H(1s) + O^+(^4S; ^2D; ^2P)$; $H^+ + O(^3P) \rightarrow H(2s) + O^+(^4S)$. The cross sections for the last process are approximately $1/9$ of the cross sections for the second process, and thus they obey the n^{-3} law of Oppenheimer. This fact supports the use of this rule for estimating the cross sections for capture into all s states of hydrogen for each residual ion. Estimates of (2s) and (1s) orbital capture are also obtained; the cross sections for (2s) orbital capture from $N(^4S)$ and $O(^3P)$ are compared, and it is found that the process becomes significant relative to p-orbital capture for an impact energy somewhat below 1 Mev for nitrogen, and somewhat above 1 Mev for oxygen; however, (2s) orbital capture dominates (2p) orbital capture from both atoms for impact energies above 8 Mev. Estimates of the Born cross sections do not differ a great deal from the experimental cross sections per gas atom for capture from the corresponding diatomic molecules. (auth)

22485 ELECTRON CAPTURE FROM $He(1s^2)$ BY PROTONS. [PART] II. Robert A. Mapleton (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Rev., 130: 1839-40(June 1, 1963).

The Born prior and post cross sections are calculated for the process, $H^+ + He(1s^2) \rightarrow H(1s) + He^+(1s)$, using the six-parameter helium wave function of Hylleras. The prior-post discrepancy is usually less than 1% in the energy range 40 kev to 1 Mev. Thus, the wave function is apparently adequate for this type of scattering calculation. These new cross sections are compared with the corresponding old cross sections calculated with the wave function; the new average cross sections, average of prior and post, are usually less than the old average values. The BK (Brinkman-Kramers) cross sections are also calculated. Although the new BK values are usually less than the old values, the new BK cross section at 10 Mev exceeds the old value by 47%. (auth)

22486 PROTON-TRITON ELASTIC SCATTERING BELOW 1 Mev. Nelson Jarmie, M. G. Silbert, D. B. Smith, and J. S. Loos (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 130: 1987-9(June 1, 1963). (LADC-5621)

Cross sections for proton-triton elastic scattering were measured between 163 and 520-kev c.m. energy for a scattering angle of 120° cm. A hydrogen gas target was bombarded with tritons accelerated by an electrostatic generator. Recoil protons emerging at a laboratory angle of 30° were analyzed with a 16-in. radius, 180° double-focusing magnetic spectrometer. The cross section is 180 mb/sr at 163 kev, rises to a broad maximum of 240 mb/sr near 275 kev, and falls gradually to a value of 207 mb/sr at 520 kev. The standard deviations in the absolute cross sections range from 4 to 9%. The energy region studied includes the region of excitation in the compound nucleus, He^4, in which there was evidence for a 0^+ excited state. The implications of the results for the question of the existence of an excited state of He^4 require a theoretical analysis of the data. A search for monopole electron pairs from a $0^+ \rightarrow 0^+$ transition was made with indeterminate results. (auth)

22487 NEUTRON-PROTON SCATTERING BELOW 20 Mev. H. Pierre Noyes (Stanford Univ., Calif.). Phys. Rev., 130: 2025-33(June 1, 1963).

Critical examination and analysis of existing n-p scattering data below 20 Mev reveal that they provide quantitative information only about the S-wave scattering lengths and effective ranges, which are found to be $\alpha_t = 5.396 \pm 0.011$ F; $a_s = -23.678 \pm 0.028$ F; $r_t = 1.726 \pm 0.014$ F; $r_s = 2.51 \pm 0.11 \pm 0.043$ F; in which the second error quoted for r_s is a conservative estimate of the uncertainty due to departures from the shape-independent approximation. The correlations in error are $(\delta\alpha_t\delta\alpha_s) = -0.7828\delta\alpha_t\delta\alpha_s$; $(\delta\alpha_t\delta r_s) = -0.8547\delta\alpha_t\delta r_s$; $(\delta\alpha_s\delta r_s) = 0.7029\delta\alpha_s\delta r_s$. An estimate of the contribution to the total cross section from scattering in higher angular momentum states, based on model calculations, p-p phases, and the $\cos\theta$ term in the differential cross section, allows the deviation from the shape-independent approximation to be computed at 14.1 and 19.665 Mev from total cross-section measurements. It is shown on theoretical grounds that this must come almost entirely from the $^1S_0$ state, and extreme limits to this variation are established. The value found is close to zero at both energies, in accord with theoretical expectations, but the uncertainty is so large that it barely excludes the extreme limits. Some qualitative evidence for or against the existence of the long-range one pion exchange interaction in this state could be obtained by improving the experiments below 5 Mev, but the uncertainty arising from the non-S wave scattering precludes any but qualitative results. It is shown that this uncertainty cannot be removed by improved measurement of the differential cross section because 8 independent pieces of experimental information are required. It is concluded that the energy variation of the S waves below 20 Mev cannot be measured without recourse to experiments that separate the spin states of the particles, such as spin-correlation, triple scattering, polarized-beam polarized-target, etc. If some information is taken from p-p scattering and some from theory, a single such measurement in each system might suffice; this minimal program is briefly discussed. (auth)

22488 ELECTRON-PROTON SCATTERING AT HIGH MOMENTUM TRANSFER. K. Berkelman, M. Feldman, R. M. Littauer, G. Rouse, and R. R. Wilson (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 130: 2061-8(June 1, 1963).

The elastic electron-proton scattering cross section was measured at laboratory angles between 90° and 144° and and for values of the four-momentum transfer squared between 25 and 45 F^{-2} (incident electron laboratory energies from 830 to 1360 Mev). Both the scattered electrons and the recoil protons were momentum analyzed and counted in coincidence, making possible background-free measurements down to cross sections of the order of 10^{-35} cm^2/sr. The data are consistent with the Rosenbluth formula, and the resulting form factors tie on well with previous measurements at lower momentum transfer, continuing the established trend. (auth)

22489 TEST OF CHARGE SYMMETRY OF K^+ AND K^0 MESONS IN THE ASSOCIATED PRODUCTION PROCESS. Janice B. Shafer (Univ. of California, Berkeley), Frank S. Crawford, Richard Hubbard, et al. Phys. Rev., 130: 2077-9(June 1, 1963). (UCRL-10244(Rev.))

The charge symmetry of K^+ and K^0 mesons was tested by comparing π^+ and π^- interactions at 1.23 Bev/c in the 72-in. deuterium bubble chamber. About 350 events of the type $\pi^+ + d \rightarrow K^+ + \Lambda(\text{or } \Sigma^0) + p$ and approximately 700 events of the type $\pi^- + d \rightarrow K^0 + \Lambda(\text{or } \Sigma^0) + n$ were compared. Total cross sections, angular distributions, momentum spectra, and lambda decay asymmetries show no deviations from charge symmetry. Details on angle-momentum distributions and decay asymmetries are given. (auth)

22490 PHOTOPRODUCTION OF SINGLE NEUTRAL PIONS FROM HYDROGEN AT ENERGIES 0.6 TO 1.2 Bev. R. Diebold (California Inst. of Tech., Pasadena). Phys. Rev., 130: 2089-97(June 1, 1963). (CTSL-39)

Measurements of the differential cross section for the process $\gamma + p \rightarrow \pi^0 + p$ were made at three pion center-of-mass angles: 60°, 90°, and 120°. Values were obtained at intervals of 0.05 Bev (incident laboratory photon energy, k) from approximately 0.6 to 1.2 Bev. Most of the data were obtained by detecting only the recoil protons with a large, wedge-shaped, single-focusing magnetic spectrometer and associated equipment. For $\theta^*_{\pi^0} = 60°$ and $k \leq 0.94$ Bev the π^0 decays were also required, the decay photons being detected by a lead glass total absorption counter. Although the experimental resolution was considerably narrower than that of most of the previous experiments, its averaging effect was still appreciable in certain regions. Using a six-parameter fit, the data at each angle were unfolded in an effort to eliminate the effects of resolution and to obtain the true cross sections as a function of energy. The results compare reasonably well with those of previous experiments once differences in resolutions and systematic errors are taken into account. The results did not agree with the predictions of a simple resonance model with the resonance quantum numbers suggested by Peierls. The positions and widths of the two cross-section peaks in this energy region are quite similar to those observed in π^-p scattering. (auth)

22491 NONLEPTONIC HYPERON DECAYS IN THE POLE APPROXIMATION AND THE STRONG-COUPLING CONSTANTS. Jogesh Chandra Pati (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 130: 2097-2104 (June 1, 1963).

The nonleptonic hyperon decays $Y \rightarrow N + \pi$ in the baryon pole approximation, assuming the validity of the $|\Delta T| = \frac{1}{2}$ rule for the weak two-fermion ($Y \rightarrow N$) vertices are considered. The ($\Sigma\Lambda$) relative parity is assumed to be even. An attempt was made to solve for the two strong-coupling constants g_Σ and g_Λ and the four weak-vertex parameters involved in ($\Sigma \rightarrow N$) and ($\Lambda \rightarrow n$) transitions from the known hyperon-decay parameters. It is found that there exist three solutions if $\Sigma^+ \rightarrow n + \pi^+$ proceeds via S wave; and only one solution if $\Sigma^+ \rightarrow n + \pi^+$ proceeds via P wave. These solutions are quite different from those given previously by Singh and Udgaonkar; the main reason for the difference is the value used for the |P/S| ratio in $\Lambda \rightarrow p + \pi^-$ decay. The four solutions are applied to radiative $Y \rightarrow N + \gamma$ decays and experiments that could distinguish between these solutions are pointed out. Given the results of a few experiments, one may be in a position to choose the most favored solution and predict the results of other experiments, thus, subjecting the model to a direct test. (auth)

22492 CONSEQUENCES OF A WEAK VECTOR BOSON FOR THE DECAY $K \rightarrow \mu + \nu + \gamma$. Edw. S. Ginsberg and R. H. Pratt (Stanford Univ., Calif.). Phys. Rev., 130: 2105-9(June 1, 1963).

Consequences of an intermediate vector boson, with arbitrary anomalous magnetic and quadrupole moments, were investigated for the decay $K \rightarrow \mu + \nu + \gamma$. The results of a numerical calculation indicate that such a boson will have observable effects if its mass is not too great. Emission of photons at large backward angles with respect to the energetic muons is significantly enhanced. Emission of high-energy photons at small forward angles is suppressed. The dependence of these effects on the mass and magnetic moment of the boson is discussed. Photon polarization phenomena are noted. (auth)

22493 THRESHOLD MOTION OF REGGE POLES. Bipin R. Desai (Indiana Univ., Bloomington) and Roger G. Newton. Phys. Rev., 130: 2109-11(June 1, 1963).

The motion of Regge poles as $E \to 0$ is examined in detail. It follows from the well-known threshold law of the S matrix that infinitely many poles approach $l = -\frac{1}{2}$, from the first and the third quadrants as $E \to 0+$, and from the second and third as $E \to 0-$. A possible way of including these poles in a representation of S is indicated. (auth)

22494 EFFECTS OF THE ρ MESON ON NUCLEON FORM FACTORS. J. S. Ball and D. Y. Wong (Univ. of California, San Diego). Phys. Rev., 130: 2112-16(June 1, 1963).

The isovector charge and anomalous magnetic moment form factors of the nucleon are calculated assuming that the low-energy part of the spectral function is determined by the two-pion intermediate state and the high-energy part of the spectral function can be represented by a subtraction constant. The results are compared with experimental analysis in the form of a pole plus a subtraction constant for each form factor. The spectral function is given in terms of the pion form factor ($2\pi \to \gamma$) and the $N\bar{N} \to 2\pi$ amplitudes. The phase of $2\pi \to \gamma$ as well as $N\bar{N} \to 2\pi$ are determined in terms of $\pi\pi$ p-wave phase shift that is adjusted to fit the observed ρ-resonance with a mass of 760 Mev and a full width of ~130 Mev. In the calculation of the $N\bar{N} \to 2\pi$ amplitudes, the exchange of a nucleon and a (3-3) resonance are included as Regge poles. Two parameters are introduced in the Regge pole description. These parameters are adjusted to fit two constants a_1 and a_2 obtained from the experimental analysis of the form factors. The effective mass of the two-pion state that results from the present calculation is approximately 600 to 650 Mev, in good agreement with the experimental determination. (auth)

22495 SEPARABLE POTENTIALS IN THE COMPLEX l PLANE. A. N. Mitra (Indiana Univ., Bloomington) and J. D. Anand. Phys. Rev., 130: 2117-26(June 1, 1963).

The analytic behavior of a certain kind of nonlocal separable potentials is studied in the complex angular momentum plane. The amplitude derived from such potentials has cuts only in the locations expected for the Mandelstam representation, including one corresponding to the crossed channel. The spectral functions are explicitly evaluated. A study of the singularities in the complex l plane of the partial wave amplitudes shows that there is only one Regge trajectory to the right of the Rel = −3/2, and that its behavior is that of the principal Regge trajectory corresponding to a Yukawa potential. This is confirmed through the evaluation of the high-energy limit of the total amplitude in the cross channel. (auth)

22496 PHASE REPRESENTATION OF ANALYTIC FUNCTIONS. Masao Sugawara and Arnold Tubis (Purdue Univ., Lafayette, Ind.). Phys. Rev., 130: 2127-31(June 1, 1963).

The phase representation that expresses an analytic function essentially in terms of its phase along the cuts is discussed. In particular, the precise conditions under which this phase representation is valid and also the asymptotic behavior of the phase representation are studied in detail. It is proved that the asymptotic behavior is essentially the same at infinity in all directions. The derivation of the high-energy behavior of scattering amplitudes and the N/D representation of the partial-wave amplitude are discussed as applications of the phase representation. Finally, the phase representation is used in determining the total numbers of zeros of the forward pion-nucleon scattering amplitudes. It is found that the charge nonexchange amplitude has either 2 or 4 zeros, depending upon the signs of the S-wave scattering lengths, while the charge exchange amplitude has 11 zeros. (auth)

22497 SPONTANEOUS BREAKDOWN OF OCTET SYMMETRY. S. L. Glashow (Univ. of California, Berkeley). Phys. Rev., 130: 2132-4(June 1, 1963).

A model of strong interactions with the octet symmetry of Gell-Mann and Ne'eman is considered, and a spontaneous breakdown of this symmetry leading to nondegenerate baryon masses is sought. The Gell-Mann mass formula is deduced for the physically relevant symmetry-breaking solutions. (auth)

22498 UNITARITY AND CAUSALITY IN A RENORMALIZABLE FIELD THEORY WITH UNSTABLE PARTICLES. M. Veltman (Rijksuniversiteit, Utrecht). Physica, 29: 186-207(Mar. 1963). (In English)

The problems of unitarity, causaility, and renormalizability are treated in a field theory containing an unstable particle. Perturbation theory is suitably modified and leads to an implicit equation for complete propagators. The S-matrix constructed with these propagators and connecting stable particle states only is shown to be unitary, renormalizable, and causal. It is also shown to give rise to interpolating Heisenberg fields that verify the original field equations. (auth)

22499 THE S-WAVE π-π SCATTERING. N. Hu and G. Z. Yang (Peking Univ.). Sci. Sinica (Peking), 12: 317-26(Mar. 1963). (In English)

The S-wave π-π scattering amplitude is calculated by using the chain approximation from the unrenormalizable interaction Lagrangian that gives rise to the same P-wave scattering amplitude as obtained by Frazer and Fulco from the dispersion relation. It is found that the S-wave amplitude contains two additional parameters. This appearance of new parameters is inevitable since the interaction is unrenormalizable. The connection of our method of solution with that of the dispersion relation is also discussed. The calculation gives rise to a low-energy resonance in the I = 0 state that may be identified as the resonance observed by Booth. (auth)

22500 A SUGGESTED EXPERIMENT TO DETERMINE THE SPIN OF Y_1^* AND THE PARITIES OF $\Lambda-\Sigma$, $\Lambda-Y_1^*$ AND $\Sigma-Y_1^*$. Zhao-bin Su, Chong-shou Gao, and Kuang-chao Chou (Peking Univ.). Sci. Sinica (Peking), 12: 451-2(Mar. 1963). (In English)

From observation of the final state $\Lambda-\pi$ resonance and the cusp arising from the near threshold effect of Σ-production in π-p reactions, the spin of the Y_1^* hyperon and the relative parities of $\Lambda-\Sigma$, $\Lambda-Y_1^0$, and $\Sigma-Y_1^*$ may be determined. (D.C.W.)

22501 ON THE THEORY OF NONLOCAL POTENTIAL. O. G. Sitenko and O. V. Drobachenko (Khar'kov State Univ. and Khar'kov Aviation Inst.). Ukr. Fiz. Zh., 7: 5-10(Jan. 1963). (In Ukrainian)

Yamaguchi's theory of nonlocal potential is applied to the problem of proton scattering by protons, taking into account the Coulomb interaction between them. Relations are established between the parameters of scattering and nonlocal potential, and their numerical values are found. (auth)

22502 ANALYTICAL PROPERTIES OF PARTIAL WAVE AMPLITUDES OF SCATTERING OF CHARGED PARTICLES. III. ARBITRARY l; POINT PARTICLES. Yu. L. Mentkovskii (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 7: 17-25(Jan. 1963). (In Ukrainian)

Investigations were conducted on the analytical properties of partial wave amplitudes of scattering of charged point particles at any l. It is proved that there exists a function $S_l^N(k)$, simply connected with $S_l(k)$ that does not have (at the cut off nuclear part of the potential $v(\varphi)$) a jump in the upper k-half-plane, and may therefore be used for constructing dispersion relations on the first Riemann E-sheet. It may be expected that with non-cut off $v(\varphi)$ even $S_l^N(k)$ is discontinuous in the upper half-plane, but the discontinuity does not begin at the point $k = 0$ and does not exclude the possibility of constructing dispersion relations. (auth)

22503 ANALYTICAL PROPERTIES OF PARTIAL AMPLITUDES IN SCATTERING OF CHARGED PARTICLES. IV. FREIDHOLM METHOD. Yu. L. Mentkovskii (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 7: 144-5(Jan. 1963). (In Ukrainian)

It is shown that Freidholm and Walter equations may be used to resolve an ordinary nuclear Coulomb problem. (R.V.J.)

22504 ALLOWING FOR SELECTION RULES FOR THE SCATTERING OF PARTICLES WITH UNEQUAL MASSES ON DETERMINING ANALYTICITY DOMAINS FOR CONTRIBUTIONS FROM DIAGRAMS. I. I. Kostyrko (Inst. of Mathematics, Kiev.). Ukr. Fiz. Zh., 7: 1046-50(Jan. 1963). (In Ukrainian)

The method is given for obtaining domains of analyticity in the real s, t−plane for the contributions from the diagrams for concrete processes of the scattering of particles with unequal masses, allowing for selection rules. As an example the process of nucleon−nucleon scattering, π meson−nucleon scattering and K meson−nucleon scattering are studied. This problem is of great significance for the investigation of the analytic properties of partial waves. (auth)

22505 STRONG INTERACTIONS AT HIGH ENERGIES. N. G. Birger, V. D. Mikhailov, I. L. Rozental, and L. I. Sarycheva. Usp. Fiz. Nauk, 79: 523-44(Mar. 1963). (In Russian)

Data on high-energy particle interactions were analyzed and correlated with theoretical predictions. The basic theory and results obtained by means of ordinary quantum field theory are discussed. The cross sections for π meson and nucleon interactions with nucleons at 2 to 28 Bev and cosmic particle interactions with nuclei were analyzed and correlated with theoretical calculations. 83 references. (R.V.J.)

22506 IONIZATION LOSSES OF FAST ELECTRON ENERGY IN THIN FILMS. A. I. Alikhanyan, G. M. Garibyan, M. P. Lorikyan, A. K. Valter, I. A. Grishaev, V. M. Petrenko, and G. L. Fursov. Zh. Eksperim. i Teor. Fiz., 44: 1122-24(Mar. 1963). (In Russian)

Measurements of ionization losses by super-fast particles were carried out using a linear accelerator and 20.5, 40, 47.5, and 88 Mev electron beams focused on 10^{-6} cm thick polystyrene films coated on 10 μ of aluminum. The measurements indicate there is no density effect in thin films and that ionization losses increase logarithmically with electron energy, confirming the method of measuring particle energies by ionization losses. (R.V.J.)

22507 ABSORPTION OF STOPPED π-MESONS IN CARBON. V. S. Demidov, V. G. Kirillov-Ugryumov, A. K. Ponosov, V. P. Protasov, and F. M. Sergeev (Moscow Inst. of Engineering Physics). Zh. Eksperim. i Teor. Fiz., 44: 1144-6(Apr. 1963). (In Russian)

Stars produced by mesons (π^-) stopped in a four liter propane bubble chamber are investigated. The distribution of the stars with respect to number of prongs is determined; the mean number of prongs is 0.84. The distribution of two-prong stars with respect to the angle between the prongs was also measured and found to have a sharp peak at angles close to 180°. Both results indicate a two-nucleon mechanism of meson (π^-) absorption by the carbon nucleus. The probability of meson (π^-) absorption by an np pair is 70%. (auth)

22508 DOUBLE MOTT SCATTERING OF ELECTRONS. L. A. Mikaelyan, A. A. Borovoi, and E. I. Denisov (Inst. of Atomic Energy, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1162-70(Apr. 1963). (In Russian)

Asymmetry values of double scattering of electrons on gold are obtained in the energy range from 45 to 245 kev and angles between 90 and 150°. The results are compared with those of experimental and theoretical investigations. (auth)

22509 γ-RADIATION FROM HIGH-SPIN NUCLEI. Yu. Ts. Oganesyan, Yu. V. Lobanov, B. N. Markov, and G. N. Flerov (Joint Inst. of Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1171-9(Apr. 1963). (In Russian)

The energy spectra of the γ rays produced in the interaction of accelerated O^{18} and Ne^{22} ions with Cu, Ta, W, and U nuclei are investigated in the 74 to 145 Mev energy range with help of a single-crystal scintillation spectrometer. In each decay of the compound nucleus, up to 13 γ quanta with energies from 0.7 to 1.1 Mev were observed. The effect of the spin of the excited nucleus on the decay mechanism is discussed. (auth)

22510 ON THE PROPERTIES OF THE SHIFTS IN P-SPACE OF CONSTANT CURVATURE. Yu. A. Gol'fand (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1248-61(Apr. 1963). (In Russian)

The shifts in constant curvature space that are one of the main elements of generalized field theory are studied in detail. A characteristic feature of the shifts is found (focusing property) of which no analogy exists in the usual Euclidean case. A more refined formulation of the field theory apparatus is presented. Deviations from the law of conservation of energy-momentum in scattering processes are considered. It is shown that the law of conservation of energy-momentum remains valid in the generalized theory for elastic scattering of fermions. The focusing feature results in an interaction anomaly in the particle-antiparticle system. The formation of bound states of such systems during contact interaction with a small coupling constant is briefly discussed. (auth)

22511 CONSERVATION OF VECTOR CURRENT IN WEAK INTERACTIONS AND THE MASS DIFFERENCE IN ISOTOPIC MULTIPLETS. THE $\pi^+ \to e^+ + \nu + \pi^0$ DECAY. M. V. Terentev (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1320-8(Apr. 1963). (In Russian)

A proof is presented for the theorem that the vector coupling constant, which is linear in the particle mass difference in isotopic multiplets, is not renormalized in neutron and hyperon (Σ) β decay and $\pi^+ \to \pi^0 + e^+ + \nu$ decays. The theorem is valid in all orders in strong interactions. The probability for $\pi^+ \to \pi^0 + e^+ + \nu$ decay is calculated by taking into account radiative corrections. Application of the theorem restricts the degree of indeterminacy of the theoretical value of the probability. (auth)

22512 EFFECT OF INELASTIC PROCESSES ON SCATTERING OF ELECTRONS BY POSITRONS AND ELEC-

TRONS. L. I. Lapidus (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1333-6 (Apr. 1963). (In Russian)

With the aid of dispersion relations it is shown that the effect of inelastic processes, including the production of strongly interacting particles, is not large and cannot significantly affect the analysis of experiments performed with the aim of verifying the validity of electrodynamics in experiments with colliding beams. (auth)

22513 ON γ_5-SYMMETRY IN WEAK INTERACTIONS AND DECAYS WITH $\Delta S = -\Delta Q$. E. M. Lipmanov (Volgagrad Pedagogical Inst., USSR). Zh. Eksperim. i Teor. Fiz., 44: 1396-1400(Apr. 1963). (In Russian)

The assumption of an additive law of lepton charge conservation and of the presence of definite electron and muon spiralities in weak interactions uniquely define the lepton pairs (ν_e, e^-) and (ν_μ, μ^-) in four-fermion interactions with baryons only in the case of V-coupling. The assumption that V-coupling is violated and hence lepton pairs of the type $(\tilde{\nu}_\mu, e^-)$ and $(\tilde{\nu}_e, \mu^-)$ are involved in lepton decays of strong particles with $\Delta S = -\Delta Q$ is also discussed. (auth)

22514 ON PAIRS WITH A NON-ZERO ANGULAR MOMENTUM IN FERMI SYSTEMS. I. A. Privorotskii (Inst. of Physics and Tech., Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 44: 1401-8(Apr. 1963). (In Russian)

The properties of a Fermi system with a non-zero angular momentum pair interaction are investigated. Uncoupling of the three-particle Green function that yields a solution with isotropic and anisotropic gaps is suggested. It is shown that the solution with the anisotropic gap is asymptotically exact. The difficulties that appear in deriving the solutions with the isotropic gap are discussed. (auth)

22515 EMISSION OF A SINGLE CHARGE IN SEMI-FINITE WAVEGUIDE FILLED WITH DIELECTRIC. E. L. Burshtein and G. V. Voskresenskii. Zh. Tekhn. Fiz., 33: 34-42(Jan. 1963). (In Russian)

Studies were made of Vavilov-Cherenkov radiation from a point charge in a semi-infinite waveguide filled with a dielectric. It was found that damping waves propagate from the waveguide plane with a group velocity that compensates the Cherenkov radiation. (R.V.J.)

22516 ON THE THEORY OF PAIR CREATION BY EXTREMELY RELATIVISTIC CHARGED FERMIONS: THE TRIDENT PROCESS. Harold Saul Zapolsky. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 163p.

The standard techniques of quantum electrodynamics are used to write the Feynman amplitudes for the trident production processes: $e^- + (Z,A) \rightarrow e^- + e^+ + e^- + (Z,A)$; and $\mu^- + (Z,A) \rightarrow \mu^- + e^+ + e^- + (Z,A)$ in the static field approximation. The four diagrams which represent these amplitudes are divided into two "strong" or "γ-pair" amplitudes and two "weak" or "γ-e" amplitudes. Order of magnitude estimates of the contributions of these two classes of diagrams to the total cross section are obtained. A formalism is derived for representing the various terms in the cross section by Feynman amplitude diagrams of sixth order. With the aid of these diagrams and Furry's theorem, the contribution to the total cross section from the interference between the γ-pair and γ-e amplitudes is shown to vanish. An order of magnitude estimate is made for the exchange terms which enter into the cross section for electron tridents, and they are found to give a negligible contribution to the total cross section. On the basis of these results, a calculation of the total cross section is performed, starting from the eight-fold differential cross section obtained from the two γ-pair amplitudes only and applying the relativistic small angle approximation. The validity of the relativistic small angle approximation is examined, and the calculated cross section is estimated to be accurate to 5%. The theoretical cross section is compared with recent measurements of electron tridents, and found to be in good agreement with these experiments in the energy range between 100 Mev and 10 Bev. (M.P.G.)

22517 EVIDENCE FOR A PION-PION RESONANCE FROM PHOTOPRODUCTION OF PION PAIRS. Donald Wingrove McLeod. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 173p.

Differential cross sections for $\gamma + p \rightarrow \pi^+ + \pi^- + p$ were measured using two magnet spectrometers in coincidence, one detecting the proton and the other one of the pions, in an attempt to observe effects of final state pion-pion interactions. The experimental set up is described. The magnet angles and momenta were varied in such a way that the π-π center-of-mass total energy or effective π-π mass was varied while the π^+-p and π^--p center-of-mass energies were held constant in an attempt to minimize variations due to pion-nucleon final state interactions. One pion-nucleon energy was held below the 3/2-3/2 resonance energy, at 1140 Mev total energy in one program and 1163 Mev in another program, while the other one was in the valley between the 3/2-3/2 resonance and the second resonance, at 1420 Mev. Half the data were taken with the π^- at the lower energy, half with the π^+ lower. The π-π total energy was then varied from 400 to 760 Mev. A peak at a 2-pion final state mass of about 720 Mev was seen on plots of the Lorentz invariant matrix element squared $|M|^2$ vs double-pion total energy. This is probably due to the ρ^0 double-pion resonance seen by other authors. Effects probably coming from the 3/2-3/2 pion-nucleon resonance affecting the final state were also seen, in particular as a substantial splitting outside the ρ^0 peak between the $|M|^2$ with the π^+ or the π^- at the lower pion-nucleon energy. The results are discussed in terms of a simple model for the final-state π-π and π^--nucleon interactions. (M.P.G.)

22518 POLARIZATION IN K^+-p SCATTERING. Malcolm Clifford Whatley. Thesis, Madison, Wis., Univ. of Wisconsin, 1963. 60p.

The polarization of the recoil proton in K^+-p elastic scattering is studied in a 30-in. propane bubble chamber exposed to a separated K^+ beam at 750 Mev/c. There are 166 events in which the recoil proton scatters elastically from a carbon nucleus with analyzing powers ranging from 5 to 95%. The distribution of these events is compared with the polarization predictions based on phase shifts found elsewhere from angular distributions at 810 Mev/c. Of the 3 repulsive solutions, the $p_{1/2}$ is favored slightly (2 to 1 odds) over the $s_{1/2}$, while the solution which is primarily a mixture of $p_{1/2}$ and $p_{3/2}$ is improbable with betting odds of 1 in 16. (Dissertation Abstr.)

22519 A THEORY OF PHOTON TRANSPORT IN DISPERSIVE MEDIA. Edward Harris Klevans. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 136p.

A systematic, self-contained development of an equation describing photon transport in a dispersive, nonrelativistic medium is given. The photon balance equation is exhibited as a time rate of change of a coarse-grained photon-distribution function. The photons described have an energy-momentum relation $\hbar\omega = (hc|\underline{k}|)/(\mu)$, where μ is the index of refraction. Transport of these photons is characterized by a photon speed which is different from the speed of light. Transition probabilities for scattering,

emission, and absorption processes are computed to the lowest nonvanishing order. Radiation from a plane plasma layer is studied, and reasonably good agreement with experiment is obtained, although the radiative transfer equation for the dispersive medium is not found to be in agreement with the more conventional equation, which is developed by phenomenological balance considerations. Photon transport through an Einstein-model crystal is considered. The scattering cross section developed in x-ray scattering theory is obtained. In the limit of the infinite homogeneous crystal, the Bragg scattering condition emerges. The transport equation developed here is expected to be valid when (a) the medium is isotropic, (b) spatial variation of particle and photon distributions is slow over regions characterized by a length many times larger than the maximum wavelength of photons under consideration, and (c) the frequency is sufficiently above resonance regions (or the plasma frequency for the fully ionized gas) so that radiation damping effects can be ignored. These conditions are only intended to be sufficient for the validity of the equation, but may not be necessary. (M.P.G.)

22520 APPLICATION OF DISPERSION AND PERTURBATION THEORETIC TECHNIQUES TO THE STUDY OF THE RADIATIVE CORRECTIONS TO WEAK INTERACTIONS AND THE CONSERVED $\Delta S = 0$ VECTOR CURRENT THEORY. Clifford Rodney Schumacher. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 171p.

The electromagnetic radiative corrections to muon and nucleon decay are studied using both dispersion and perturbation theoretic techniques. An analysis is made of disagreements in the earlier published results, and their differences are removed and accounted for. Various sources of ambiguity and possible improvements are investigated. Particular attention is given to the modifications of the weak vertex and the electromagnetic vertices due to the strong interactions, and it is shown that the answer is almost completely insensitive to the model of nucleon electromagnetic structure chosen to treat the final state electron-proton scattering. The gage properties of the solution are examined, and these are used to exclude a possible dependence upon the difference between the electromagnetic structures of protons and electrons. It is shown that the perturbation theory amplitude has the required analytic character in the cut plane for dispersion relations to be valid by analytically continuing it into the inelastic scattering region, where its discontinuity across the cut is evaluated and shown to be identical with the corresponding absorptive part calculated from unitarity. It is concluded that the source of the discrepancy between theory and experiment for the muon lifetime, based on the Conserved Vector Current Theory, must be sought in the structure of the weak vertex. It is shown that the implications of the CVC theory regarding the modifications of the structure of the weak vertex due to the strong interactions require that photons be emitted from it, and that these may have an amplitude of the proper magnitude and sign so that the radiative corrections to nucleon decay become very small. The muon lifetime discrepancy would then no longer be alarming. (Dissertation Abstr.)

22521 DETERMINATION OF THE SPIN OF THE Mu MESON. Menasha Joseph Tausner. Thesis, New York, Columbia Univ., 1962. 54p.

It is shown that if all neutral massless fermions found in nature have a spin of $\frac{1}{2}$, then the spin of the mu meson is also $\frac{1}{2}$. The method of proof is the following: The most general distribution function for the high-energy electrons emitted in the muon decay is determined for the different possible values of the muon spin, and it is shown that the observed angular distribution is consistent only with the assignment of spin $\frac{1}{2}$ to the muon. The distributions used are the most general ones consistent with angular-momentum conservation and are not further restricted by means of any assumptions about specific models of muon interactions. (Dissertation Abstr.)

22522 ON HYPERON-NUCLEON SCATTERING. Cornelis Dullemond. Thesis, Rochester, N. Y., Univ. of Rochester, 1962. 156p.

With the help of global symmetry and modern nucleon-nucleon potential models, hyperon-nucleon potential models are constructed, and Schrödinger equations are solved for the hyperon-nucleon system. These then lead to generalized phase shifts and mixing parameters and finally to scattering cross sections and other experimental parameters. Both G^+ and G^- symmetry have been employed and a comparison with experiment has been made. (Dissertation Abstr.)

22523 ELASTIC SCATTERING AND PHASE SHIFT ANALYSIS OF π^+ + P NEAR 30 Mev. David E. Knapp. Thesis, Rochester, N. Y., Univ. of Rochester, 1962. 128p.

To increase the angular range and accuracy of elastic pion proton scattering measurements, 5 measurements of π^- + p differential cross sections and three measurements of π^+ + p differential cross sections were made. The main achievement of the measurements is to reduce the uncertainty in the $T = \frac{1}{2}$ phase shifts to 10 to 15%. The results combined with previous measurements at 30 Mev, were used to find a 5-parameter phase-shift solution with only α_{33} fixed by data from other energies. The inability of the 30 Mev data to provide a solution for all 6 phase shifts is shown to be a characteristic of measurements at this energy. From the phase-shift solution, the quantity $a_1 - a_3 = 0.254 \pm 0.015$ was predicted, a value in statistical agreement with the prediction $a_1 - a_3 = 0.245 \pm 0.01$ for the same quantity from photoproduction measurements. The total cross sections $\sigma^{2+} = 6.15 \pm 0.12$ mb/sterad, $\sigma^{-0} = 7.02 \pm 0.22$, and $\sigma^{2-} = 1.847 \pm 0.080$ were also predicted. Finally, the nonresonant P-wave phase shifts follow the general trend indicated by recent theoretical predictions for the effect of a pion-pion resonance on these phase shifts at moderate energies. (M.P.G.)

22524 THE MEASUREMENT OF THE PROTON-PROTON DIFFERENTIAL SCATTERING CROSS SECTION AT 210 Mev. Andrei Konradi. Thesis, Rochester, N. Y., Univ. of Rochester, 1962. 148p.

The proton-proton differential scattering cross section at 210 Mev was measured with as great an accuracy and over as wide an angular range as possible. The experiment was done by measuring the relative cross section from 30° to 90° c.m., and by normalizing it to a value extrapolated from the absolute measurements of other people at near-by energies. The results of the relative measurement show greater precision than had previously been achieved at 240 Mev. The shape of the differential cross section shows good agreement with the phenomenological predictions of Bryan and Hamada, and with the energy dependent solutions 1(16) obtained from the phase shift analysis of MacGregor, Moravcsik, and Stapp. (Dissertation Abstr.)

22525 THE LOW ENERGY TWO PION INTERACTIONS. Tran Nguyen Truong. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 100p.

The low energy two-pion interactions are studied from

the dispersion relation approach of Chew and Mandelstam and from the phenomenological viewpoint. An approximate solution to the Chew-Mandelstam pion-pion scattering equations is obtained based on two parameters which can be fixed by the experimental knowledge of the position and width of the P-wave resonance. This enables a determination of the low-energy S-wave amplitudes. Within the uncertainty in the experimental determination of the width of the resonance, the limits $0.9 \lesssim a_0 \lesssim 1.7$ and $0.25 \lesssim a_2 \lesssim 0.40$ are obtained, where a_0, a_2 are, respectively, the S-wave isospin 0 and 2 scattering lengths in the unit of pion compton wave length. A reformulation of the Watson final-state interaction theory is made and is applied to the phenomenological analysis of the pion-pion final-state interaction in the ABC experiment and to the τ and τ' decay. From the study of the τ and τ' spectra, it is unlikely that a_0 could be larger than 2.5. This is in agreement with results obtained from the Chew-Mandelstam equations and does not contradict the results of the ABC experiment. (Dissertation Abstr.)

22526 COMPARISON OF THE QUANTUM MECHANICAL AND FIELD THEORETICAL AMPLITUDES FOR THE PHOTODISINTEGRATION OF THE DEUTERON. Francis S. Troyon. Thesis, Rochester, N. Y., Univ. of Rochester, 1962. 112p.

The problem of the photodisintegration of the deuteron is interesting, because the process involves a bound state but is a two-particle to two-particle reaction for a wide range of energy. It is shown that, at low energies, it is possible to represent the photodisintegration as a matrix element between a wave-function of the final nucleons and another energy-independent quantity analogous to the deuteron wave-function. The interest of this wave-function approach is the reduction of a two-variable problem (energy and angle) to a one-dimensional one. The object which plays the role of the deuteron wave-function has the same asymptotic behavior as the wave-function and the same location of the anomalous cuts, but differs in inner regions. It can be thought of as the product of the usual deuteron wave-function and an interaction, although what is determined is the product. This is done for scalar particles; taking the spins into account would necessitate the introduction of as many "wave-functions" for the bound state as there are channels, namely 12. (M.P.G.)

22527 AN INVESTIGATION OF PION-PION INTERACTIONS IN THE REGION OF THE SECOND AND THIRD PION-NUCLEON RESONANCES. Charles Clyde Peck. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 131p.

Using a homogeneous sodium-iodide luminescent chamber, the effective mass spectra of the two pions produced in the reaction $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ has been studied at incident pion energies of 871, 775, and 682 Mev. A comprehensive survey of similar experiments is included to provide perspective for the interpretation of the results. A peak in the effective mass spectra with incident pions of 871 Mev is found between 580 and 660 Mev with high momentum transfers to the proton dominating. The possible relationship of this phenomenon to the existence of a J meson is discussed. Additionally, the possibility of peaking structures near 540 Mev in both the 775 and 682 Mev data is considered, with considerable reservation because of possible large errors. Finally, a possible tendency for the accumulation of events in the 350 Mev region of the effective mass spectrum is seen in the data collected at 682 Mev. The possibility that large systematic errors negate this final result does exist. The importance of the fact that this experiment was run in the vicinity of the second and third pion-nucleon resonances is emphasized in interpreting the results and comparing it to similar experiments. (Dissertation Abstr.)

22528 PARITY EXPERIMENT TRACK MEASURING UNIT (Engineering Materials). (Argonne National Lab., Ill.). 61 units. (CAPE-945)

The projector, plotting table, scanning unit, and screen and control system are used with a spark chamber as a measuring device in a $\Sigma\Lambda$ parity experiment. The spark chamber is an effective type of visual track chamber. The experiment is a measurement of the polarization of neutral sigma hyperons produced by negative pions on protons requiring the identification of the sigma and the observation of its production plane and its decay products namely the lambda and gamma ray. (F.L.S.)

Neutron Physics

22529 (AD-282968) TRUNCATION ERRORS IN NUMERICAL SOLUTIONS OF THE TRANSPORT EQUATION (thesis). John H. Bennett (Harvard Univ., Cambridge Univ., Cambridge, Mass.). May 1962. Contract Nonr-1866(34). 225p.

The numerical solution of the transport equation for monoenergetic neutrons in a medium with isotropic scattering is given. The object is to determine the accuracy of the numerical methods generally used to solve the transport equation. The analysis is largely confined to the solution of the criticality problem for homogeneous slabs. A criticality problem in x−y geometry is also considered. The criterion of accuracy used is the difference between c, the number of secondary neutrons per collision required for criticality, and an approximation to c given by an n-parameter approximate method. 93 references. (auth)

22530 (AERE-R-4299) ON MEASURING THE NEUTRON SCATTERING FORM FACTORS ASSOCIATED WITH SPIN WAVES. G. G. E. Low and A. Okazaki (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1963. 12p.

Use of the concept of Slater type spin waves for neutron scattering in certain metals is briefly discussed, and two approaches to measuring the form factor for scattering from spin waves in neutron scattering experiments are examined. An incoherent scattering experiment in which the diffuse neutron intensity from spin wave scattering in a binary ferromagnetic alloy would be observed and a small angle coherent scattering experiment in which the scattered neutron intensity at the position of the cut-off angle arising from ferromagnetic spin wave scattering around the forward direction would be observed are considered. (D.C.W.)

22531 (HASL-126) A COMPUTER PROGRAM FOR CALCULATING NEUTRON INTERACTION BETWEEN CYLINDRICAL STORAGE CONTAINERS. Stephen Lanes and Theodore Rosenberg (New York Operations Office. Health and Safety Lab., AEC). Feb. 1963. 36p.

A machine method for the calculation of neutron interaction between cylindrical storage containers in square or rectangular arrays with either square or rectangular pitch is presented. The only input data required by the computer are the physical dimensions of the array and of the containers. In applying this computational approach, the program will handle any array up to and including 20×20 units. With certain assumptions and modifications (depending on the particular problem), it may also be used to

partially analyze a three dimensional system. Use of the subroutine features of the Fortran II system overcame several difficulties in setting up the program. The complete program requires one mainline program and four sub-programs. The Fortran II system is also available for computers other than the IBM-1620 for which it was chosen in this program. As the program now stands, it may be compiled on any machine that is able to use the Fortran II system. (auth)

22532 (KAPL-2165-1) KARE—A SYSTEM OF DIFFUSION THEORY PROGRAMS FOR THE PHILCO 2000. VOLUME I. GENERAL DESCRIPTION, INPUT INSTRUCTIONS, AND OUTPUT DETAILS. J. A. Archibald, Jr. and H. L. Teaford (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 20, 1962. Contract W-31-109-eng-52. 249p.

The present KARE system provides semiautomatic calculations of neutron group constants, criticality, spatial distribution of neutron fluxes and fission sources, fuel and poison depletion, and lumped fission fragment poisoning effects throughout life. The group constant calculations are done by solving the few-group approximations of the multigroup diffusions which may be cylindrical, rectangular, or hexagonal (also referred to as triangular). In the two latter cases, diagonal mesh boundaries and region interfaces are permitted. KARE also includes a multichannel flux synthesis calculation, perturbation calculations, a calculation of gamma radiations, and a calculation of space- and spectrum-dependent thermal fluxes. A general technical description of the entire system and a detailed description of the input and output are given. (auth)

22533 (MMPP-NPC-1-1) RECENT DEVELOPMENTS IN NEUTRON TRANSPORT THEORY. K. M. Case (Michigan. Univ., Ann Arbor. Michigan Memorial-Phoenix Project). [1961]. 44p.

The method of elementary solutions for neutron transport equations is examined under the assumption that all the neutrons have the same speed and that they are passing through a homogeneous and isotopic medium. General solutions are obtained by the superposition of elementary solutions. The Green's function for a uniform, infinite medium is calculated as an example. A generalized partial range completeness theorem is proved, and the solutions to some half-space problems are written as a superposition of elementary solutions, with application of the appropriate boundary conditions giving the expansion coefficients. Further applications and extensions of the method are considered. (D.C.W.)

22534 (MMPP-NPC-1-2) RESONANCE ABSORPTION OF NEUTRONS. L. W. Nordheim (General Atomic Div. General Dynamics Corp., San Diego, Calif.). [1961]. For Univ. of Michigan, Michigan Memorial-Phoenix Project, Ann Arbor. Contract [AT(04-5)-187]. 68p.

A consistent theory of neutron resonant absorption is presented. Expressions for the Doppler broadened capture cross section and the scattering cross section are derived. Expressions for the fluxes and resonance integrals are derived for resonance absorption in both homogeneous and heterogeneous mixtures. Calculations of the resonant integrals made with several approximations are given for uranium rods. Equivalence relations equating the resonance integrals for homogeneous and heterogeneous assemblies on the basis of cross section relations are derived along with geometry dependences of the resonance integrals. Neutron penetration-depth dependence on resonant structure is also treated as is resonance absorption in closely packed assemblies. A numerical method for calculating resonance integrals is included, and results of calculations for uranium rods are compared with relations derived from experimental work. Temperature dependence of the resonance integral is also treated. Good agreement between theory and experiment is obtained. (D.C.W.)

22535 (MND-MC-2856) GENERALIZED MONTE-CARLO PROGRAM FOR NEUTRONS—GMCM-9. M. Kniedler and T. Jordan (Martin-Marietta Corp. Aerospace Div., Baltimore). July 15, 1962. Contract AF 33(616)-6818. 196p.

GMCM-9 is a FORTRAN coded three-dimensional, multiregion, multienergy group, neutronic random walk solution for reactor and shielding problems. Estimates are provided on the neutron flux within various zones of the configuration, the leakage at outer boundaries, and the criticality of reactor configurations. Answers are also obtained on the number of neutrons emerging from elastic scattering, inelastic scattering, and fission for the various materials. The program takes time into account, and may be used to obtain the above answers for successive time periods to investigate the time-dependent nature of a particular reactor configuration. (auth)

22536 (SAM-TDR-63-18) PRELIMINARY DOSE MEASUREMENTS ON THE NEUTRON GENERATOR. Paul J. Ebert and Ronald W. Benson (School of Aerospace Medicine, Brooks AFB, Tex.). Mar. 1963. 6p. (AD-402108)

Neutron fluxes are produced by the neutron generator at the USAF School of Aerospace Medicine, using the $d(d,n)He^3$ and $T(d,n)He^4$ reactions. An experimental procedure for determining the flux produced by the $d(d,n)He^3$ reaction is presented. Dose calculations are briefly discussed. (auth)

22537 (TID-18481) ADDENDA TO NEWSLETTERS NO. 3 AND NO. 4. Reactor Physics Constants Center Newsletter No. 9. H. Greenspan and I. G. Baksys (Argonne National Lab., Ill.). Mar. 1963. Contract W-31-109-eng-38. 92p.

The addenda include a revised table of cross sections and scattering law for water. Other addenda are also included. (J.R.D.)

22538 (TID-18565) DIFFUSION PARAMETERS AND SPECTRA FOR PULSED WATER ASSEMBLIES. Robert L. Hobson and P. B. Daitch (Rensselaer Polytechnic Inst., Troy, N. Y.). Apr. 4, 1963. Contract [AT(30-3)-328]. 30p.

The eigenvalues and eigenfunctions of the time-dependent energy-dependent diffusion equation for water at 23°C were determined for various geometries described by a buckling B^2. Exact numerical "experiments" are performed using a digital computer to obtain the diffusion parameters in water by fitting the exact points by the method of least squares. The results indicate a zeroth eigenvalue expansion of the forms $\lambda = 36{,}882\ B^2 - 2924\ B^4 + 167\ B^6$ where a transport correction was applied to the B^4 term. The sensitivity of the expansion coefficients to the order of polynomial used to fit the points and to the range of bucklings used is investigated. The effects of the formulation of D(E) on the coefficients is also investigated and a simple D(E) proportional to v of $D(E) = 0.11133\sqrt{E/0.0255}$ cm is found to work well in water. (auth)

22539 (TID-18587) THE SCATTERING OF SLOW NEUTRONS BY POLAR LIQUIDS (thesis). Sidney Yip (Michigan. Univ., Ann Arbor. Michigan Memorial-Phoenix Project). June 1962. 168p.

A quasi-crystalline model of polar liquids for the analysis of slow-neutron scattering is proposed. Effects of the

macroscopic medium are considered in terms of specific potentials that hinder molecular translations and rotations. By smearing the neighboring molecules over a spherical distribution and choosing a two-particle interaction that includes dipole-dipole forces, an effective potential for the center-of-mass degrees of freedom is derived. A sufficient condition for the parabolic approximation to this potential is established. Hindrance in the rotational motion is treated by means of a coupling between the permanent electric dipole moment of the molecule and a local electric field that represents orientation-dependent effects of intermolecular forces. Under the condition of strong coupling, this hindering potential leads to useful wave functions for symmetric and linear molecules that describe free as well as hindered rotations. On the basis of the present treatment of molecular translations and rotations, the energy and angular differential scattering cross section is calculated without introducing further approximations. Particularly simple expressions are obtained when free-rotation energies are ignored. Energy distributions of neutrons scattered by hydrogen chloride and water are calculated. It is shown that hindered rotation effects are experimentally observable whereas the structure associated with hindered translations can be observed only by means of high-resolution measurements. The present results provide a suitable basis for systematic studies of medium effects in polar liquids by inelastic slow-neutron scattering. Specific experiments are suggested. 67 references. (auth)

22540 INVESTIGATION OF THE INELASTIC SCATTERING OF COLD NEUTRONS BY CERTAIN HYDROGENOUS MATERIALS. M. G. Zemlyanov and N. A. Chernoplekov. At. Energ. (USSR), 14: 257-63(Mar. 1963). (In Russian)

In view of the increasing importance of polyphenyls and polyethylene as moderator materials, the inelastic scattering phenomena of cold neutrons by hydrogenous materials must be known in order to solve the neutron thermalization problem and to clarify the excitation spectrum of saturated, unsaturated, and aromatic hydrocarbons. Unirradiated and irradiated polyethylene, benzene, and diphenyl were used for the tests. The cold-neutron spectrum was separated by means of a Be filter, and the energy distribution of the scattered neutrons was determined by the time-of-flight method. Only a slight difference was noted between the spectra of irradiated and unirradiated polyethylene; on the other hand, the results of the tests, carried out at 20°C, indicated a special behavior which could not be detected in the optical spectrum of the materials. For a more detailed study of the noted effects a spectrometer with an increased resolution must be used; in addition, measurements should be carried out at various temperatures, including points below and above the melting and softening points of the materials. (TTT)

22541 MOMENTS OF THE NEUTRON TIME-ENERGY DISTRIBUTION AND THE USE OF RANDOM FUNCTIONALS. Martin A. Leibowitz (International Business Machines Corp., Yorktown Heights, N. Y.). J. Math. Phys. (N. Y.), 4: 446-50(Mar. 1963).

The time moments of the neutron time–energy distribution are derived under the following conditions: infinite homogeneous moderator with no absorption, elastic scattering, and distribution of scattering angle independent of energy in center-of-mass frame. However, no assumption is made on the variation of the scattering cross section with energy. The moments are derived in two ways: first, by means of Laplace transforms, and then through the use of random functionals. Random functionals were not previously employed in neutron moderation theory and they offer certain advantages that are discussed. (auth)

22542 A VARIATION OF THE PULSED SOURCE METHOD FOR THE MEASUREMENT OF THE DECAY CONSTANT OF THERMAL NEUTRONS IN GRAPHITE. Fritz von Muehlen (Universität, Frankfurt am Main). Nukleonik, 5: 1-3(Jan. 1963). (In German)

It is shown that the time decay constant of thermal neutrons in moderators can be obtained by varying the duration of the input pulse and measuring the neutron intensity in the moderator in dependence on the duration of the input pulse at fixed time intervals from the pulse end. The solution of the diffusion equation, on the basis of which the measurement method was explained, was derived. The experimental arrangement used was described, and the results obtained for reactor graphite are given as an example. (tr-auth)

22543 THE DEFINITION OF A SUITABLE "MEAN" NUMBER OF COLLISIONS IN THE SLOWING DOWN OF NEUTRONS. H. Kuesters (Kernforschungszentrums, Karlsruhe, Ger.). Nukleonik, 5: 33-9(Jan. 1963). (In German)

In the slowing down of neutrons of a given initial energy, E_0, on stationary moderator atoms, the mean number of collisions, which leads to slowing down below an energy E_T, is customarily calculated with the utilization of the mean logarithmic energy decrements. Mathematically completely equivalent to this calculation of the collision number (from the attainable mean lethargy after $\underline{n}$ collisions) is the determination form of the mean energy after $\underline{n}$ collisions. These methods are mostly approximate since the collision number so defined was not obtained by averaging the mean over the corresponding distribution functions. The errors arising were discussed. It was shown that the collision number obtained from the mean lethargy for scatterers with small atomic number deviates only slightly from the exact values. The values obtained from the mean energy are always too large. In the limiting case of heavy scattering centers (high atomic number), the collision numbers obtained from the mean lethargy attained exceeds the exactly calculated mean collision numbers. From statistical considerations, a linear relation between lethargy and collision number for scatterings on heavy nuclei is obtained. Although the fundamental definition is generally known, the comparison here considered is only incompletely carried out in the literature of neutron physics. (tr-auth)

22544 POLARIZATION EFFECTS IN THE MAGNETIC ELASTIC SCATTERING OF SLOW NEUTRONS. M. Blume (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 130: 1670-6(June 1, 1963). (BNL-6657)

The theory of the elastic scattering of polarized neutrons by magnetic crystals with ordered spins is developed. Several terms that were omitted by Halpern and Johnson in their original treatment of the subject are discussed. These terms vanish in the case of scattering from simple ferromagnetic or antiferromagnetic structures, but they give rise to some interesting effects in more complex structures. Among these is a polarization effect that occurs in antiferromagnetic spirals, and an effect that allows the determination of the imaginary part of the form factor in noncentrosymmetric systems. General formulas for the cross section and for the polarization of the scattered beam are given for arbitrary spin orderings. (auth)

22545 SLOW-NEUTRON SCATTERING BY HINDERED ROTATORS. Sidney Yip and R. K. Osborn (Univ.

of Michigan, Ann Arbor). Phys. Rev., 130: 1860-4 (June 1, 1963).

Using a description of a rotator in a strong static electric field the scattering of low-energy neutrons by a condensed system of polar molecules with only rotational degrees of freedom is discussed. Energy and angular differential scattering cross sections for symmetric and linear molecules are derived. It is shown in the case of symmetric molecules that there exist inelastic effects of the same order of magnitude as free-rotation transitions. A simple expression useful for the description of hindered rotation excitations is given. The cross section for water is computed and compared with measurements and existing theory. (auth)

22546 LOW-VOLTAGE NEUTRON GENERATOR FOR MONOCHROMATIC NEUTRONS. B. A. D'yachkov and E. M. Oparin. Pribory i Tekhn. Eksperim., No. 1, 23-6 (Jan.-Feb. 1963). (In Russian)

Descriptions are given of a low-voltage neutron generator producing monochromatic fluxes of 3×10^9 n/sec (2.5 Mev) and 1 to 2×10^{11} n/sec (14 Mev). The accelerator tube produces deuteron beams to 5 ma. The stabilized high-voltage generator is equipped with a multiplication scheme supplied by a f = 2.5 Hz tube generator. (tr-auth)

22547 NEUTRON SCATTERING ON CRYSTALS WITH IMPURITY NUCLEI AND THE PROBLEM OF RECONSTRUCTION OF THE VIBRATIONAL SPECTRUM. Yu. Kagan and Ya. Iosilevskii. Zh. Eksperim. i Teor. Fiz., 44: 1375-95(Apr. 1963). (In Russian)

Neutron scattering on crystals of arbitrary symmetry with isolated impurity atoms is considered. The cross sections for coherent and incoherent scattering corresponding to single-quantum excitations in the system are determined. The problem of separating that part of the incoherent cross section which is connected with scattering on impurity atoms and on the surrounding perturbation regions is analyzed. It is demonstrated that this part of the cross section contains direct information on the nature of the impurity atom vibrations and information on the frequency density distribution function of the phonon spectrum of an ideal crystal. (auth)

22548 THE THEORY OF NEUTRON SLOWING DOWN IN NUCLEAR REACTORS. Joel Henry Ferziger. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 417p.

Those parts of reactor theory which pertain to the prediction of reactor criticality are reviewed. In addition, new results are presented which establish the range of validity of the asymptotic reactor model and several theorems, the proofs of which have not previously appeared in the literature, are proven. The derivation of the Boltzmann Equation and the scattering frequency required therein as well as the major results of asymptotic reactor theory are presented. It is shown that, by treating thermal neutrons by the one group approximation, the criticality problem can be converted to one of calculating certain slowing down kernels. Most of the results are well known, but new derivations and the discussion of the validity of the asymptotic model appear to be original. The slowing down kernels are calculated. The methods employed are of general utility in reactor physics and may be used in more realistic reactor models. Slowing down in an infinite medium is treated and the resonance escape probability is calculated in several approximations, including one which has not been previously published. Models for calculating neutron distributions in space and energy in finite media are presented. Again, the major portion of the results is not new, but the proofs of a few previously unpublished theorems are given. Numerical methods which are often used in reactor calculations are discussed. In the appendices, some extensions of asymptotic reactor theory and a discussion of the limitations of the model are given as well as the proofs of some theorems quoted in the text. (Dissertation Abstr.)

Nuclear Properties and Reactions

Refer also to abstracts 21649 and 22165.

22549 (AROD-2543:8) A TIME CORRELATION TECHNIQUE FOR INVESTIGATING TWO CONNECTED NUCLEAR TRANSFORMATIONS. Final Report, October 1960–June 1962. Wesley O. Doggett (North Carolina State Coll., Raleigh. School of Physical Sciences and Applied Mathematics). 10p. (AD-297538)

Research on a time correlation method for measuring daughter half lives in the range 10^{-4}-1 sec is reported. Expressions were derived for the average value and variance of the prompt correlation function for a long-lived parent and a delayed daughter with mean life λ^{-1} and with uncorrelated background present. The previous complicated expression derived for the variance for a delayed cascade was reduced to a tractable expression, and the analysis was extended to include background influence. Correlation functions and variances were obtained for the case of appreciable parent decay. Expressions for the average value and variance of the correlation function for a prompt daughter with appreciable parent decay were also obtained. A measurement of about 3% accuracy for daughter mean lives on the order of 0.1 sec during a period of one day can be achieved. General relations were developed for determining the daughter decay constant λ from experimental data for the correlation function using a weighted least squares criterion. (D.C.W.)

22550 (BNL-6931) OPTICAL MODEL ANALYSIS OF HEAVY ION SCATTERING. E. H. Auerbach and C. E. Porter (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 21p.

Disadvantages of using semi-classical models for the analysis of elastic scattering of heavy ions by nuclei are pointed out, and optical model analysis is shown to be feasible and realistic. Optical model calculations were made using a program encompassing a maximum of 140 partial waves. Ratios of the differential elastic scattering cross sections to the Rutherford cross section were calculated for C^{12}, N^{14}, Ne^{20}, and O^{16} incident on Au^{197} and for O^{16} incident on Bi^{209}. Comparison is made with data. (D.C.W.)

22551 (CERN-63-9) ON THE MULTIPLE SCATTERING OF PARTICLES FROM EXTENDED NUCLEI. H. Oeveras (European Organization for Nuclear Research, Geneva). Mar. 26, 1963. 73p.

Moliere's small-angle theory can be used to obtain the multiple scattering distribution for situations in which nuclear form factors in the cross section of extended nuclei do not affect the distribution. A procedure for calculating the modified distribution resulting from form factor effects in large momentum transfer scattering experiments is presented. The final scattering angle is considered to be made up of one large and many small single scatterings. The angular distribution is obtained with a precision of about 1%. (D.C.W.)

22552 (EACRP-U-6) INHERENT UNCERTAINTIES IN CALCULATED URANIUM RESONANCE INTEGRALS. R. Vernon (Switzerland. Eidgenössisches Institut für Reaktorforschung, Würenlingen). Feb. 1963. 10p.

Effects of uncertainties in resonance parameters on the total uranium resonance integral and on the temperature coefficient of the integral were calculated using the ARES resonance integral program. Probable inherent errors in the resonance integral and the temperature coefficient are also given. (D.C.W.)

22553 (EANDC(E)-43L) COMPILATION OF REQUESTS FOR NUCLEAR CROSS SECTION MEASUREMENTS FROM EURATOM COUNTRIES. J. Spaepen (European-American Nuclear Data Committee). Jan. 1963. 23p.

Requests by Euratom countries for neutron cross section data are compiled. Requests are divided into three groups: those requiring immediate attention, those warranting some priority, and those of general interest. (D.C.W.)

22554 (FZM-1042) FISSION PRODUCT GAMMA RAY SPECTRA. J. F. Scoles (Convair, Fort Worth, Tex.). [Aug. 1, 1958]. 9p.

Uranium-235 fission product gamma spectra were calculated for various reactor operating histories. An IBM-704 digital computer program was coded to compute the gamma energy contributed by each fission product gamma ray and to sum these results in energy groups. A representative curve showing the decay of various energy groups is presented. Comparisons are made with data previously reported. (auth)

22555 (JINR-P-1214) GEOMETRICHESKII EFFEKT V REAKTSIYAKH SRYVA NA DEFORMIROVANNYKH YADRAKH. (Geometric Effect in Stripping Reactions on Deformed Nuclei). V. K. Lukyanov and A. G. Fokin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 7p.

In calculating the spectroscopic factors in the stripping reactions on deformed nuclei it is necessary to take into account the so-called "geometric" correction due to the necessity of performing the integration in Butler's integral from the R radius as a function of the parameters of the deformation in a nucleus. A comparison with experiment is given for $Mg^{25}(d,t)Mg^{24}$ reaction. It is shown that such a correction to the relative reduced widths may amount to about 20%. (auth)

22556 (JINR-P-1218) NEITRONNYE REZONANSY BROMA. (Neutron Resonances of Bromine). D. Zeliger, N. Iliesku, Kim Hi San, D. Longo, L. B. Pikelner, and E. I. Sharapov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1963. 18p.

Using detectors of the capture γ rays and of scattered neutrons, the neutron resonances of bromine were investigated by the time of flight technique in the range of neutron energies up to 400 ev. The parameters of fifteen resonances were obtained. For nine resonances the spins of levels were determined. For five levels, J = 1 and for four, J = 2. (auth)

22557 (JINR-P-1223) RADIATSIONNYI ZAKHVAT REZONANSIYKH NEITRONOV YADROM Pr^{141}. (Radiative Capture of Resonance Neutrons by a Pr^{141} Nucleus). Ya. Urbanets (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1963. 11p.

Spectra of high-energy γ rays emitted in the capture of the resonance neutrons by Pr^{141} nucleus were measured with the aid of a single scintillation spectrometer. From measurements the relative intensities of the ground transition were determined for 6 first resonances. It follows from the character of γ ray spectra that in contrast to previous reports the resonance 85.1 ev is due to the capture of s-neutrons. (auth)

22558 (JINR-P-1244) KVAZIKLASSICHESKII ANALIZ UPRUGOGO RASSEYANIYA SLOZHNYKHYADER. (Quasi-Classical Analysis of Elastic Scattering of Complex Nuclei). B. N. Kalinkin, T. P. Kochkina, and B. I. Pustylnik (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 13p.

The quasi-classical analysis of the elastic scattering of heavy ions is made for a number of concrete cases. Theoretical results are in a good agreement with experimental data. The parameters characterizing the nuclear interaction proved to be sufficiently stable for different combinations of colliding nuclei. (auth)

22559 (LADC-5551) NUMERICAL SOLUTION TO COUPLED B.C.S. EQUATIONS. Thomas A. Oliphant (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 9p.

Nuclear matter is treated by the Bardeen-Cooper-Schrieffer (BCS) approach. The previous repulsive core treatment is dropped allowing calculations without going into configuration space. Solutions to the nonlinear coupled BCS equations are therefore obtained very simply by a numerical procedure. A Yukawa potential with range 1.5 f and a depth of 10 Mev replaces the repulsive core potential. Binding energy per particle turns out to be about 16 Mev with a second Born approximation contribution of about 1 Mev per particle. Binding energy per particle is found to shift between 90 and 100 kev. (D.C.W.)

22560 (NP-12643) ANALYSE DES RESULTATS DE LA COMPARAISON INTERNATIONALE DE ^{204}Tl. (Analysis of Results of the International Comparison of Tl^{204}). J. C. Roy and L. Cavallo (Bureau International des Poids et Mesures, Sevres, France). Mar. 1963. 38p.

In May 1962 the National Physical Laboratory, Teddington, Great Britain, distributed to 21 laboratories samples of Tl^{204}. A critical and detailed examination of the results reported by 19 of these laboratories was made. The possible and probable causes of the wide variation of the absolute value of the activity of the Tl^{204} solution are analyzed. The analysis seemed to show that the variation can be explained largely by errors introduced in the following corrections: self-absorption, beta absorption in the support, and efficiency of detection of radiations caused by electron capture. Absorption of betas does not seem to pose a problem when the scintillating liquid, scintillating liquid on filter paper, and scintillating gel methods are used. (J.S.R.)

22561 (NP-12658) AN INVESTIGATION OF THE THERMAL NEUTRON CROSS-SECTION FOR THE REACTION $N^{14}(n,p)C^{14}$ USING A NUCLEAR EMULSION TECHNIQUE (thesis). Richard Maxwell Gowing (Pennsylvania State Univ., University Park). June 1961. 67p.

An attempt was made to determine the thermal neutron cross section of the $N^{14}(n,p)C^{14}$ reaction by exposing Li^6 and N^{14} to a thermal neutron beam at the Pennsylvania Research Reactor and recording the proton tracks of the N^{14} reaction and the triton tracks of the Li^6 reaction in a nuclear emulsion. The relation between the number of tracks per unit volume and the cross section was to give the N^{14} reaction cross section relative to the Li^6 reaction cross section. Only an upper limit could be established for the $N^{14}(n,p)C^{14}$ cross section (5 ± 1 b) due to various causes. Theory, experimental procedures, experimental results, and sources of errors are discussed. 20 references. (D.C.W.)

22562 (NP-12660) GAMMA-GAMMA ANGULAR CORRELATION IN THE DECAY OF COBALT 60 (thesis). Burton J. Conway (Naval Postgraduate School, Monterey, Calif.). 1961. 62p.

Work by Verser on the angular correlation of gamma rays from Co^{60} decay gave a correlation curve in disagreement with the theoretical curve. A rerun of the cobalt-60 experiment was made to confirm the results obtained in the previous work. A comparison of the previous work confirms that there is a definite distortion in the shape of the observed correlation function. The statistical analysis of the data and the solid angle corrections required for evaluation of the results were programmed for calculation on the 1604 digital computer. The programs are given in detail. (auth)

22563 (NP-12663) AN INVESTIGATION OF THE LOW EXCITED STATES OF Cr^{52} (thesis). Robert Roland Wilson (Colorado. Univ., Boulder. Graduate School). 1961. 103p.

The low excited states of Cr^{52} were investigated by studying the decay of Mn^{52} with 3 NaI(Tl) crystals (1 large, 2 small) as singles and in coincidence gating a 200-channel pulse height analyzer. The results of a concurrent study of Mn^{52} decay with the University of Colorado $\sqrt{2}\,\pi$ double-focusing beta-ray spectrometer are also presented. The energies given are those of the beta-ray spectrometer studies, and the intensities given are those of the weighted average of the results of both spectrometers. The gamma-ray energies and intensities reported were (all kev): 1433.6 ± 0.4 (100%), 1332 ± 1 (5.8%), 1245.6 ± 0.4 (6.2%), 1214 ± 1 (2.8%), 935.1 ± 0.4 (87.1%), 847.4 ± 0.6 (2.3%), 743.8 ± 0.3 (84.0%), 345.74 ± 0.08 (0.9%), annihilation quanta (65.5%). Weak transitions seen were: 2650 ± 30 (0.08%), 1463 ± 2 (0.3%), 1180 ± 20 (1.4%), 1070 ± 20 (3.2%), 630 ± 60 (2.4%). New decay schemes for Mn^{52} and Mn^{52m} were proposed. The energy, spin, and parity of the excited levels of Cr^{52} were given as (all Mev): 3.832 (5+,6+), 3.800 (2+), 3.74 (7±), 3.614 (5+,6+), 3.480 (3+), 3.161 (1-,2-,3-), 3.112 (6+), 2.965 (2+,3+), 2.766 (4+), 2.648 (0+), 2.369 (4+), and 1.434 (2+). Of interest are the 5 newly proposed excited levels of highest energy, the 9 newly reported gamma rays, the intensity differences of the 3 main transition gamma rays from those previously reported, the support given to the assignment of spin and parity by D. M. Van Patter to the triplet between 3.112 and 2.369 Mev, and the assignment to the 3.161 Mev level as the first odd parity state. 74 references. (auth)

22564 (ORNL-3383) MONTE CARLO CALCULATIONS ON INTRANUCLEAR CASCADES (thesis). H. W. Bertini (Oak Ridge National Lab., Tenn.). May 16, 1963. Contract W-7405-eng-26. 230p.

Submitted to Univ. of Tennessee, Knoxville.

The basic assumption of the Serber model in the description of high-energy nuclear reactions is that the interactions of incident particles with complex nuclei can be described in terms of individual particle-particle collisions within the nucleus. Calculations were performed making use of the basic assumption of the Serber model, a more realistic nuclear model, recent cross-section data, and an exact statistical sampling technique. The sampling technique has not been used previously in calculations of this type. Calculations were performed for incident π^+, π^-, neutrons, and protons on nuclei from lithium to uranium. The energy range of the incident particles varied from about 50 to 350 Mev, i.e., the energy region in which pion production is not likely. Free-particle cross sections were used in determining the collisions within the nucleus, and statistical sampling techniques were used throughout. The problem was coded for the IBM-7090. Extensive comparisons with experiment were made and the results indicate that the calculation can be used to predict most of the cascade data for incident nucleons on complex nuclei, but only the gross features of the data are predictable for incident pions on nuclei. The effects of several nuclear configurations on the results of the calculations were investigated in some of the areas where discrepancies exist between the experimental results and those of the calculation. These configurations consisted of uniform and non-uniform nucleon density distributions in spherically symmetric nuclei of various radii. The results of these investigations indicate that the greatest effect is due to the nuclear dimensions rather than the nucleon density distribution within the nucleus for a given nucleon volume. 77 references. (auth)

22565 (TID-15266) FIRST-EXCITED STATE IN Mg^{26}. R. D. Lawson (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-eng-38. 3p. (UAC-6000)

In support of evidence for a new state in Mg^{26} at 1.33 Mev with spin zero, the existence of such a state is shown not to conflict with the rotational model. The possibility of observing this state in a (d,p) reaction is suggested. (D.C.W.)

22566 (TID-18590) NEUTRON RESONANCE INTEGRAL AND AGE DATA. Reactor Physics Constants Center. Newsletter No. 10. P. J. Persiani, J. J. Kaganove, and A. E. McArthy (Argonne National Lab., Ill.). Apr. 1, 1963. Contract W-31-109-eng-38. 36p.

Results of new calculations and measurements of neutron resonance integrals for various isotopes are presented. Most of the integrals involved calculations taking into consideration negative energy levels to describe more accurately low energy neutron cross sections. Ages of fission and non-fission neutrons in various mixtures, elements, and compounds are also included. (D.C.W.)

22567 (UCRL-10673) MASS-SPECTROMETRIC STUDY OF FISSION FROM THE U^{236} COMPOUND NUCLEUS AT MODERATE EXCITATIONS (thesis). James Anthony McHugh, Jr. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Feb. 12, 1963. Contract W-7405-eng-48. 90p.

The helium-ion-induced fission of Th^{232} (U^{236*}) was investigated by using high-sensitivity mass-spectrometric techniques. The nuclear-charge-distribution function was measured directly for one isobaric sequence and indirectly in another; it was found to be Gaussian and independent of the excitation in U^{236*}. An empirical Z_p function was derived from 12 measured fractional independent yields, and compared with the Z_p function from $U^{235}(n_{th},F)$. The various postulates of nuclear charge division were discussed. The total number of neutrons emitted per fission as a function of mass ratio was determined from the Z_p function, the neutron yields being found to depend strongly on the asymmetry of the fission mode. The relative cumulative yields for the majority of isotopes in the mass 131 to 154 range were determined. The xenon cumulative yields show no structure at these excitations. Information concerning the distribution of independent yields within an element and the formation of the Kr^{85} isomeric states was obtained for the helium-ion-induced fission of Th^{232} and U^{235}. 85 references. (auth)

22568 (WASH-1041) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP [AT] LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA, OCTOBER 15-16, 1962. John R. Stehn (Brookhaven National Lab., Upton, N. Y.). Contract [AT(30-2)-Gen-16]. 46p.

Cross Sections — AEC measurement program develop-

ments; Tungsten — neutron scattering by natural, total elastic cross section for fast; Tungsten Isotopes W^{184} — neutron scattering by, total elastic cross section for fast; Uranium Isotopes U^{238} — neutron scattering by, total elastic cross section for fast; Uranium Isotopes U^{235} — neutron scattering by, total elastic cross section for fast; Thorium Isotopes Th^{232} — fast neutron capture cross sections for; Molybdenum Isotopes Mo^{95} — neutron resonances in; Selenium — neutron resonance parameters and total cross section of; Magnesium — neutron total cross section for; Aluminum — neutron total cross section for; Calcium — neutron total cross section for; Vanadium — neutron total cross section for; Praseodymium — neutron scattering by, differential cross section for elastic; Argon — proton reactions (p,n) with, resonances in; Carbon Isotopes C^{12} — deuteron reactions (d,pα) with, angular correlations in; Deuterons — reactions (d,pα) with carbon-12, angular correlations in; Protons — reactions (p,n) with argon, resonances in; Nickel Isotopes Ni^{64} — energy levels structure of; Zinc Isotopes Zn^{64} — energy levels structure of; Uranium Isotopes U^{235} — photofission cross section of; Holmium Isotopes Ho^{165} — gamma reactions (γ,n) and (γ,2n) with, cross sections for; Uranium Isotopes U^{233} — fission of, prompt neutron yield per; Uranium Isotopes U^{235} — fission of, prompt neutron yield per; Plutonium Isotopes Pu^{240} — fission of, prompt neutron yield per; Plutonium Isotopes Pu^{239} — fission of, prompt neutron yield per; Cerium Isotopes Ce^{141} — neutron effective capture cross section of; Cerium Isotopes Ce^{140} — neutron capture integral and cros sections, thermal; Protactinium Isotopes Pa^{233} — neutron total cross section of, thermal; Holmium Isotopes Ho^{166} — half life of; Indium Isotopes In^{114} — isomer formation cross section and yields ratio for; Rubidium Isotopes Rb^{86} — isomer formation cross section and yields ratio for; Antimony Isotopes Sb^{122} — isomer formation cross section and yields ratio for; Carbon Isotopes C^{13} — proton reactions (p,n) with, thresholds for; Nickel Isotopes Ni^{62} — proton reactions (p,n) with, thresholds for; Protons — reactions (p,n) with carbon-13 and nickel-62, thresholds for. (D.C.W.)

22569 (AEC-tr-5783) ATOMIC NUCLEUS AS A COMPRESSIBLE DROP. I. THE GROUND STATE OF THE ATOMIC NUCLEUS. S. Fluegge and K. Woeste. Translated by Lydia Venters (Argonne National Lab., Ill.) from Z. Physik, 132: 384-?(1952). 15p.

By taking into consideration the compressibility of the nuclear substance and the possibility of substituting the neutron liquid for proton liquid, refinement of the drop model of the atomic nuclei is achieved. It appears that the protons as well as the neutrons in the nucleus with an increasing number of particles are more and more driven toward the outside. For $Z > 36$, a zone under tensile stress originates within the nucleus. In the proximity of the upper limit of the periodic system ($Z = 91$) this tensile stress becomes so intense that the average hydrostatic pressure within the nucleus vanishes. Due to these phenomena the increase in the nuclear radii is not strictly proportional to $\sqrt[3]{A}$ as for the incompressible nuclei, but slightly faster. For the binding energy of the incompressible nuclei a number of complementary terms originate that in general do not substantially change the variation of mass defects. (auth)

22570 (NP-tr-993) HYDROGEN ISOTOPE OF MASS 3. V. I. Chernyaev. Translated by M. Archer (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Usp. Fiz. Nauk, 21: 466-77(1939). 25p.

The method Bleakney used in his mass spectrographic search for H_1^3 in natural hydrogen and in studies of the relative abundance of H and D isotopes is examined. Mass spectrographic principles and the production of H ions are discussed. The pressure dependence and the probability for the production of ions from various H and H-D mixtures are considered; and the results of experiments to determine ion ratios, abundances of D and T in natural H and H_2O, and the existence of H_1^3 are received. The mass-3 isotope, if it exists in nature, apparently has too low an abundance to be separated readily enough. (D.C.W.)

22571 (NP-tr-1003) THE CONVERSION-ELECTRON CORRELATION. F. Gimmi, E. Heer, and P. Scherrer. Translated by J. E. Holmstrom (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Helv. Phys. Acta, 29: 147-86(1956). 70p.

The conversion-electron correlation technique was investigated by measuring the γ-γ, γ-$\bar{e}_k^-$, $e_{k_j}^-$, and e_k^--e_k^- correlations of Cd^{111}. The results were found to be in good agreement with the theory of Biedenharn and Rose. A study of the e_{k-j}^- correlation in Hg^{197} led to an unambigous choice between two possible decay schemes and indicated the spin of the ground state of Hg^{197} to be $^1/_2$. Conversion-electron correlation experiments also provided an aid in determining the decay scheme of Hf^{181}-Ta^{181}. In both these cases, the e^--γ correlation was found to be disturbed by a perturbation that was attributed to the interaction of the magnetic moment with the field of the excited electron shell. To correct the correlation function for the influence of the size of the source, new correction formulas were calculated. 50 references. (auth)

22572 STUDIES OF NUCLEAR PROPERTIES BY COINCIDENCE SPECTROMETER METHODS. DECAY SCHEMES AND TRANSITION PROBABILITIES. Jan Lindskog. Acta Univ. Upsal., No. 22, 8p.(1963). (In English)

An electron-electron coincidence spectrometer was used for decay scheme studies and lifetime measurements of excited nuclear states. A redesign of the coincidence spectrometer and development of methods for delayed coincidence measurements of nuclear lifetimes down to 10^{-11} seconds are included. The decay of Au^{194}, Pt^{194}, and Tb^{160} was studied. A measurement of the lifetime for the first excited state in Tl^{200} was reported. The result contributes to the systematics of E2-transition probabilities in this mass region. A comparison between experimental values for electric or magnetic moments and the corresponding transition probabilities for Hf^{177}, Lu^{175}, and Lu^{177} as a test of the internal consistency of a nuclear model is given. The lifetime of the 129-kev level in Ir^{191} was measured. (C.E.S.)

22573 EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF PERTURBED ANGULAR CORRELATIONS. Eckart Matthias. Acta. Univ. Upsal., No. 23, 13p.(1963). (In English)

The gyromagnetic ratio (g) of a number of nuclei are determined. For deformed even-even nuclei the rotational g-factor can be obtained directly for the excited states of the ground state rotational band ($K = 0$). In odd-A nuclei the direct measurement of the rotational g-factor is not possible as the total magnetic moment is composed of the moment arising from the rotational motion and that of the intrinsic configuration of the nucleons. The method of perturbed angular correlations and the reliability of differential and integral measurements are discussed. The explicit computation of the attenuation factors for a mixed magnetic dipole and electric quadrupole interaction is treated. A detailed discussion is given for the two most

important cases of a magnetic field applied perpendicular to the polycrystalline detector plane and parallel to the emission direction of the gammas. (C.E.S.)

22574 INTERACTION OF 29 Mev He^3 PARTICLES WITH ACETYLENE. II. INELASTIC PROCESSES. J. Catalá, A. García, and G. Pardo (Facultad de Ciencias, Valencia). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 267-72(Sept.-Oct. 1962). (In Spanish)

The results found for the inelastic processes $He^3 + C^{12}$, i.e., inelastic scattering, pick-up reaction $C^{12}(He^3,\alpha)C^{11}$ and stripping reaction $C^{12}(He^3,d)N^{13}$ for 29 Mev He^3 particles are presented. When possible, the observed angular distributions are compared with theoretical predictions. (auth)

22575 RADIOACTIVE DECAY OF Sc^{48}, Sc^{50} AND Sc^{50m}. J. Kantele (Univ. of Arkansas, Fayetteville and Univ. of Helsinki). Ann. Acad. Sci. Fennicae, Ser. A VI, No. 126, 16p.(1963). (In English)

Decay of Sc^{48}, Sc^{50}, and Sc^{50m} was studied by gamma and beta scintillation spectrometry. In the decay of 1.83-day Sc^{48}, a new 178 ± 4 kev gamma was found that establishes a new level at 3518 kev in Ti^{48} and represents 5.7 ± 1.0% of the total decay of Sc^{48}. A 23-min activity previously assigned to an isomer in Sc^{50} is shown not to belong to this nuclide. Data from searches for a short-lived isomeric state in Sc^{50} reveal a new 0.35 ± 0.05 sec activity which is tentatively assigned to Sc^{50m}. This state decays mainly via a 258 ± 8 kev isomeric transition, probably of M3 character, to the (5^+) ground state. These Sc^{50} isomers seem to form a $(2^+,5^+)$ doublet as predicted by empirical coupling rules and theoretical calculations. A value of 1.72 ± 0.04 min was measured for the half life of Sc^{50g}. Studies of the decay of this state show one beta component with an end-point energy of 3.6 ± 0.2 Mev and the following coincident gammas (and relative intensities): 524 ± 6 (97 ± 10), 1121 ± 8 (101 ± 10), and 1555 ± 10 kev (100). These radiations, together with data from other investigations, establish the following levels in Ti^{50}: 1555, 2676, and 3200 kev, the probable spin-parity assignments for these levels being 2^+, 3^-, and 4^+, respectively. The decay schemes of Sc^{48} and $Sc^{50m,g}$ are presented and discussed, and the level structure of Ti^{50} is compared with existing theoretical calculations. (auth)

22576 THE RADIATIVE CAPTURE CROSS SECTION OF TELLURIUM ISOTOPES AS A FUNCTION OF THE NEUTRON ENERGY UP TO 1.5 kev. L. S. Danelyan and B. V. Efimov. At. Energ. (USSR), 14: 264-72(Mar. 1963). (In Russian)

The dependence of the capture cross section on the neutron energy was studied on the principle of recording the capture γ rays using the linear accelerator of the I. V. Kurchatov Institute for the experiments. The aim of the work was to determine the weak neutron resonances which do not appear when measuring total cross sections and to determine the value of $b_{\theta\gamma}G$, where $b_{\theta\gamma}$ designates the cross section at the resonance maximum and G is total width. From those data the radiation width of G_γ and the spins of the levels up to several kev may be calculated. Te was chosen for these measurements because it has many isotopes and the neutron width of many levels is comparable with the radiation width; in addition, Te^{123} does not have a strong resonance at 2.334 ev and the spin of the even-odd isotopes is equal to ½. A U target of the linear accelerator surrounded by an aqueous moderator was used for the time-of-flight measurements. Many levels were found for which no previously published cross section values are available, e.g., the weak s levels of Te^{123} at 96, 109, and 118 ev. For Te^{126} up to 1500 ev, only a single level was found at 198 ± 5 ev; Te^{128} and Te^{130} did not have any levels. The data obtained do not allow definite conclusions to be drawn concerning the dependence of the parameters on the spin. (TTT)

22577 A STUDY OF THE REACTION $^{12}C + ^{12}C$. G. G. Seaman (Yale Univ., New Haven) and A. R. Quinton. Australian J. Phys., 15: 574-6(Dec. 1962).

The reaction $C^{12} + C^{12}$ was studied at an incident laboratory energy of 123 Mev. Angular distributions of the emitted α particles and protons were obtained. These angular distributions yielded values of 2.6 ± 0.3 and 1.5 ± 0.2 barns for the total cross sections for α particle and proton production, respectively. (C.E.S.)

22578 ONE-LEVEL APPROXIMATIONS IN THE THEORY OF NUCLEAR REACTIONS. C. Mahaux (Université, Liege). Bull. Soc. Roy. Sci. Liege, 32: 62-9(1963). (In French)

A one-level approximation without background is introduced in the complex eigenvalue theory of nuclear reactions. It is compared with the corresponding one in the R-matrix theory. The unitarity of the one-level approximation of the collision matrix is also discussed. (auth)

22579 APPLICATIONS OF THE ONE-LEVEL APPROXIMATION IN THE THEORY OF RESONANCES WITH COMPLEX ENERGY. C. Mahaux (Université, Liege). Bull. Soc. Roy. Sci. Liege, 32: 70-7(1963). (In French)

The cross sections of the $He^3(d,p)He^4$ and $H^3(d,n)He^4$ reactions are analyzed in terms of the one-level approximation of the complex eigenvalue theory of nuclear reactions. The fit is compared with the one obtained in the framework of the R-matrix theory. (auth)

22580 ISOTOPE SHIFTS AND INTERNAL CONVERSION OF γ RAYS. B. V. Thosar (Tata Inst. of Fundamental Research, Bombay). Current Sci. (India), 31: 368-70(Sept. 1962).

The volume effect in isotope shifts is discussed in terms of investigation of properties such as nuclear charge distribution, deformation of nuclear shape, and compressibility of nuclear matter. Measurements on volume effect in isotope shifts provide valuable information, supplementary to the results obtained from nuclear spectroscopic studies of nuclear energy levels. Detailed interpretation of volume effect in isotope shifts in the mass region, where nuclear shape deformation is pronounced, also involve consideration of specific nuclear models. Mathematical expressions are derived on the basis of the models, and values thus obtained are compared with experimental values. The data available on the 6 even isotopes of gadolinium (A = 152 to 160), samarium (A = 148 to 152), and tellurium (A = 120 to 130) are considered. The results show that trends in variation of volume effect in isotope shifts are reasonably well explained in terms of the nuclear deformation. Internal conversion processes, especially formation of excited levels, are also discussed. (TCO)

22581 CONSIDERATION OF SUPERFLUIDITY EFFECTS IN α-DECAY AT THE VIBRATION LEVELS OF THE DAUGHTER NUCLEI. M. K. Volkov and T. Veresh (Joint Inst. for Nuclear Research, Dubna, USSR). Dokl. Akad. Nauk SSSR, 148: 799-802(Feb. 1, 1963). (In Russian)

V. G. Solov'ev's superfluidity model (Doklady Akad. Nauk SSSR, 144, 1962, No. 6) was extended to the case of α decay in collective levels, making use of the Hamiltonian model of quadrupole–quadrupole interactions in the range of deformed nuclei. The neutron–proton correlations were calculated by B. L. Birbrair's method (Zhur. Eksptl'. i Teoret. Fiz., 42, 479, 1962). The effect of blocking the β-

vibration state of the daughter nucleus was not taken into consideration for the calculations but the experimental data agreed satisfactorily with the theory. This was especially noticeable in the increased value of the prohibition factor of the α decay from Cm^{242} to U^{234}. (TTT)

22582 ELASTIC SCATTERING OF FAST PROTONS BY SPHEROIDAL NUCLEAR POTENTIAL WITH DIFFUSE BOUNDARY. S. K. Dutta and N. C. Sil (Indian Assn. for the Cultivation of Science, Calcutta). Indian J. Phys., 36: 633-8(Dec. 1962).

The cross section of elastic scattering of fast protons by a deformed nucleus was calculated using the Born approximation method. The nuclear interaction is represented by an optical model potential that comprises both the prolate spheroidal shape and the diffusivity of the boundary of the potential. The Coulomb potential is taken to be that due to a uniform charge distribution within the deformed nucleus. The theoretical results for the case of tantalum nucleus (A = 171, Z = 73) obtained with a prolate spheroidal potential having diffuse boundary agree quite well with the experimental findings and the agreement is much better than that obtained with the same potential having a sharp cut-off. (auth)

22583 POLARIZATION OF PARTICLES OF INTERNAL CONVERSION FOLLOWING β DECAY. S. M. Darbinyan. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk, 16: 105-10(1963). (In Russian)

Polarization of internal conversion electrons following β decay was investigated for the case in which the β decay is described by a forbidden first order transition. In this case the matrix density $\rho_{m_2m_2'}$ assuming the initial nucleus is not polarized and the neutrino direction not recorded is represented as: $\rho_{m_2m_2'} = \Sigma_{l=0}^{3} \Sigma_{m=-l}^{l} d_l C_{I_2m_2}^{I_1m_1} Y_{lm}(\vec{n})$ (where I_2, m_2 are quantum and nuclear projection moments, $C_{b\delta d\delta}^{a\alpha}$ are Chlebsch-Gordan coefficients, $Y_{lm}(\vec{n})$ is the spherical function, n is the unit vector of the direction of β emission, and d_l is the value of certain β transitions. Thus, an analysis is made of a process in which a non-polarized nucleus with quantum numbers I_1, m_1, undergoes β decay into a nucleus with quantum number I_2, m_2, and internal conversion, followed by nuclear transition into a state with I_3, m_3. The β-decay part of the process is described by the above equation for the matrix density. (R.V.J.)

22584 THE EFFECT OF NUCLEAR STRUCTURE ON THE COEFFICIENT OF THE INTERNAL CONVERSION OF γ-RAYS. M. A. Listengarten. Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1451-8(Dec. 1962). (In Russian)

The clues to nuclear structure that can be obtained by noting the anomalies in the experimental internal conversion coefficients (ICC) as compared to theoretical values listed in the tables of M. E. Rose or L. A. Sliv are discussed. Deviations from the tabulated values of the internal conversion coefficients can be expected for strongly hindered transitions, but prior to 1960, deviations of up to 20% were observed for pure E2 transitions of the type $2^+ \rightarrow 0^+$. It is pointed out that the pure E2 transition ($2^+ \rightarrow 0^+$) with an energy of 412 kev during the decay $Au^{198} \rightarrow Hg^{198}$ was corrected to bring it in line with the theoretical value. It is necessary to assume the correct form for the angular distribution of photoelectrons. It is pointed out that β-γ coincidence counting is a reliable method of determining internal conversion coefficients. With forbidden E1 transitions of odd isotopes of the heavy elements, the magnitude of the anomaly in the internal conversion coefficient is proportional to the degree of forbiddenness of the γ transition. Thus, the magnitude of the deviation of the experimental internal conversion coefficient from the tabulated theoretical value can give information about the nuclear structure. Two independent measurements are necessary to determine the contribution of the nuclear structure to the internal conversion coefficient. (TTT)

22585 THE NATURE OF COLLECTIVE DIPOLE EXCITATIONS OF ATOMIC NUCLEI. V. V. Balashov (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1459-69(Dec. 1962). (In Russian)

According to Wilkinson's single-particle model of photonuclear reactions, the giant resonance for photosplitting is due to transfer of a nucleon to a higher shell in the nucleus. Elliott and Flowers in Proc. Roy. Soc. A, 242: 57(1957) were able to fix the position of the giant resonance for light elements correctly by taking into account residual interaction in the nucleus in describing the dipole states. Detailed calculations based on diagonalization of the energy matrix are cumbersome, and were carried out only for the magic nuclei O^{16}, Ca^{40}, and Pb^{208}. The calculations for Pb^{208} show that it is necessary to go beyond the shell model, because the giant resonance of Pb^{208} is too narrow. An additional source of broadening of the dipole state was found by taking into account the phonon surface excitations of the nucleus. Hence, a generating procedure of constructing the function of the dipole state was developed to describe the principal, macroscopic properties of the collective dipole states of average and heavy nuclei. It was found that the collective and shell interpretations of the dipole excitation are not in contradiction with each other. The dipole-dipole part of the effective interaction between nucleons plays a special role in the formation of the dipole states of a nuclei that leads to a substantial shift in the maximum of the giant resonance as compared to the single-particle estimate. The generating procedure adequately describes the main features of the giant resonance. (TTT)

22586 THE RELATIVE INTENSITIES OF Ir^{194} γ-RAYS IN THE ENERGY REGION OF 860 TO 2130 Kev. V. D. Vitman, N. A. Voinova, and B. S. Dzhelepov (Mendeleev All-Union Research Inst. of Metrology, USSR and Ioffe Inst. of Physics and Tech., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1475-9(Dec. 1962). (In Russian)

A 2 to 2.2 g sample of Ir metal was mixed with 1.3 g of graphite, and irradiated at a flux of 5×10^{13} to 1×10^{14} neutrons cm^{-2} sec^{-1}. Four samples each containing 20 to 30 curies were prepared. The relative intensities of the γ lines were obtained by investigating the spectrum of photoelectrons on a double-focusing electron spectrometer with a spectral sensitivity known to 4% in the region of 1150 to 2150 kev. A total of 23 γ lines were found that included a 1569 kev γ line decaying with a half life of 18 ± 4 hrs. The energies and relative intensities of the Ir^{194} γ lines were compared with those found by Johns and Nablo in Phys. Rev., 96: 1599(1954) and by Kern et al. in J. Nucl. Phys., 15: 566(1960). The results agree better with those of Johns and Nablo than with those of Kern et al. The multipolarities of the γ transitions from the 1671, 1622, and 1512 kev levels in Ir^{194} to the 328 and 628 levels in Pt^{194} were determined. The multipolarities of the transitions from the 1671 and 1512 kev levels to the lower 2^+ level are of the type E2 + M1. The translations from the 1622 level contain some EO type. (TTT)

22587 THE SPECTRA OF INTERNAL CONVERSION ELECTRONS EMITTED DURING CAPTURE OF THERMAL

NEUTRONS BY Er^{166} AND Er^{167}. V. A. Ivanov and V. I. Pelekhov. Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1480-5 (Dec. 1962). (In Russian)

A sample enriched in Er^{166}, a natural isotopic mixture, and a sample enriched in Er^{167} were irradiated with neutrons. Measurements of the internal conversion electrons were made on a magnetic β spectrometer having a resolution of 1.3% for 20 to 300 kev electrons and 0.6% for higher energy electrons up to 2 Mev. A comparison of the spectrum due to Er^{168} with that of the natural isotopic mixture shows that the electron energies in the Er^{167} spectrum do not exceed ~300 kev. The conversion lines belonging to Er^{167} and Er^{168} were distinguished by measurements on three targets of varying isotopic composition. The relative intensities for the conversion lines in the Er^{168} spectrum are tabulated. The ratio α_K/α_L was found to be 2.11, 3.45, and 6.4 for the 185, 285, and 816 kev transitions respectively in Er^{168}. The 185 and 285 kev transitions can be assigned to type E2. A scheme for the radiative transitions of the Er^{168} nucleus in the $Er^{167}(n,\gamma)Er^{168}$ reaction is presented. The Er^{167} spectrum showed K-, L-, and M-conversion lines for the 208 kev transition that were significantly higher than the intensities of the remaining lines in the spectrum. The ratio $\alpha_K/\alpha_L = 0.69$, and the ratio $\alpha_L/\alpha_M = 3 \pm 0.7$ for the 208 kev transition. (TTT)

22588 THE CONVERSION ELECTRON SPECTRUM OF Hf^{172}. V. Brabets, B. Kratsik, T. Kratsikova, A. Mashtalka, M. Veis, M. Vobetski, and I. Chernukh (Inst. of Nuclear Studies, Czechoslovak Academy of Sciences, Prague). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1486-7(Dec. 1962). (In Russian)

Hf^{172} was produced by a spallation reaction in a tantalum target irradiated with fast protons. The Hf^{172} fraction from the irradiated tantalum target was purified from its Lu^{172} daughter, and subjected to measurements over a period of 6 months on a β spectrometer having a resolution of 2%. No conversion lines belonging to Hf^{172} could be detected above 120 kev. The conversion electron spectrum shows 11 conversion lines corresponding to γ transitions with energies of 23.6, 42, 44.5, 81.1, 112.7, and 125.5 kev. The relative intensities of the conversion lines are given. It was not possible to determine the multipolarity of the γ transitions conclusively, and to propose a decay scheme. (TTT)

22589 THE DECAY OF Tm^{166}. E. P. Grigor'ev, B. P. Peregud, V. O. Sergeev, and V. I. Skopina (Leningrad State Univ. and Zhdanov Inst. of Physics and Tech., Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1488-91(Dec. 1962). (In Russian)

A prism β spectrometer, and a scintillation γ spectrometer were used to determine the K conversions and γ transitions in a radioactive sample of Tm^{166} ($T_{1/2}$ = 7.7 hr) which was in equilibrium with its parent Yb^{166} ($T_{1/2}$ = 58 hr). The energies of the conversion electrons were determined as the average of the results of four series of measurements. The relative intensities of the K-conversion electrons are tabulated. The energies of the γ-ray intensities were determined with the 758.9-kev γ transition being taken as a reference. The results of this study agree better with those of Grigor'ev et al [Izv. AN SSSR, ser. fiz., 25, 1217 (1961)] than they do with those of Harmon et al [Phys. Rev. 123, 1758 (1961)]. In order to determine the characteristics of the higher-lying 2134 and 2161 kev energy levels in Er^{166}, the conversion coefficients for these γ transitions were measured and compared with the known conversion coefficients of the 662-kev γ transition of Ba^{137}, and the 2614-kev γ transition in Pb^{208}. The intensity of the K-conversion line for the 2054-kev transition was a factor of 3.2 greater than that for the 2080-kev transition. The value of α_K for the (2054 + 2080)-kev transitions was found to be 0.0028 ± 0.0011. Hence, both transitions, or at least the 2054-kev transitions, have an M2 multipolarity. The parity of the 2134-kev level is negative. The most probable spin of this level is 3. (TTT)

22590 THE SCHEME OF EXCITED LEVELS IN Ir^{189} OCCURRING DURING ELECTRON CAPTURE IN Pt^{189}. L. N. Kryukova, V. V. Murav'eva, V. S. Shpinel, T. V. Malysheva, and V. A. Khotin (Moscow State Univ. and Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1492-4(Dec. 1962). (In Russian)

A platinum fraction containing Pt^{189} ($T_{1/2}$ = 10.5 hr) was isolated from a gold target irradiated with 660-Mev protons. The conversion-electron spectrum was determined on a β spectrometer. The energies of the γ transitions accompanying the electron capture in Pt^{189} are tabulated. A comparison of the relative intensities of the conversion lines at the K, L, and M shells, and at the L_I, L_{II}, and L_{III} sub-groups with the theoretical values of the conversion coefficients listed by L. A. Sliv and M. E. Rose gave information on the possible multipolarities of the γ transitions at 70.8, 81.4, 94, 113, and 175.8 kev. A scheme of levels in Ir^{189} is presented on the basis of the sums and differences of the γ-transition energies. It is assumed from analogy with Ir^{191} and Ir^{193} that the 113- and 305-kev levels in Ir^{189} are the first and second rotational levels of the principal rotational band. The 94-kev level is a single-particle level of $\frac{1}{2}$, and the 175-kev level is the first rotational level of this state. (TTT)

22591 A STUDY OF THE RADIATION OF F^{17}, P^{30}, Cl^{33} AND Br^{78}. S. S. Vasil'ev and L. Ya. Shavtvalov. Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1495-7(Dec. 1962). (In Russian)

The β^+ spectrum of the short-lived isotopes F^{17}, P^{30}, Cl^{33}, and Br^{78} was investigated by irradiating enriched targets in the vacuum chamber of a magnetic β spectrometer with a beam of particles from a cyclotron. The P^{30} activity was obtained by the following reactions: $S^{32}(d,\alpha)P^{30}$, $Al^{27}(\alpha,n)P^{30}$, and $Si^{29}(d,n)P^{30}$. A Fermi plot shows that the upper limit of the β^+ spectrum of P^{30} is E = 3.27 ± 0.05 Mev. The half life of P^{30} is 2.5 ± 0.1 min. A Cl^{33} activity was obtained from a $S^{32}(d,n)Cl^{33}$ reaction. The upper limit of the β^+ spectrum for Cl^{33} is E = 4.2 Mev, and the half life is 1.8 sec. F^{17} was obtained from an $O^{16}(d,n)F^{17}$ reaction. A Fermi plot of the β^+ spectrum of F^{17} gives a value of 1.73 ± 0.03 Mev for the maximum β^+ energy. The half life of F^{17} is 70 ± 8 sec. A Br^{78} activity was obtained by a $Se^{77}(d,n)Br^{78}$ reaction. The maximum β^+ energy of Br^{78} is 2.5 ± 0.1 Mev (lg ft = 5), and the half life of Br^{78} is 6.4 ± 0.4 min. The β^+ spectrum of Br^{78} shows another component with a maximum energy E_2 = 1.2 ± 0.2 Mev (lg ft = 4.3). The 1.2-Mev transition originates from a 1310-kev level of Se^{78}. (TTT)

22592 THE PROPERTIES OF THE LOWER EXCITED STATES OF F^{19} AND Al^{27} AS DERIVED FROM DATA ON INELASTIC PROTON SCATTERING. S. S. Vasil'ev, E. A. Romanovskii, and G. F. Timushev (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1508-17(Dec. 1962). (In Russian)

Inelastic proton scattering can give valuable information on the spin and parity of an excited state, and on the mechanism of the direct interaction. A beam of 6 to 7.5-Mev protons from a 120 cm cyclotron was directed to a CaF_2 target with a thin gold backing, and to an Al foil. The scattered protons were analyzed on a double-focusing magnetic spectrometer with the use of a ZnS scintillation counter as

a detector. The energies of the levels were in good agreement with literature values. The angular distributions of the scattered protons are compared with theoretical values for the levels at 0.198, 1.344, 1.456, 1.553, and 2.789 Mev in F^{19}. The 1.344- and 1.456-Mev levels have negative parity with quantum characteristics of $(5/2)^-$ and $(3/2)^-$ respectively. The 2.789-Mev level has an orbital moment $l = 0$, but a spin $1/2 < I < 3/2$, and a positive parity. The ground state of F^{19} is $(1/2)^+$, the 0.198-Mev level is $(5/2)^+$, and the 1.553-Mev is $(3/2)^+$. These data on the excitation cross sections of these F^{19} levels are discussed in terms of various nuclear models, and are shown to harmonize with these models. The angular distributions of Al^{27} for the levels at 0.804, 1.014, 2.216, 2.743 and 3.000 Mev are asymmetric with respect to an angle of 90°, but unlike the scattering on F^{19}, the angular distribution is similar, and only the cross section varies for the different excited levels. The parity of these levels in Al^{27} is positive, and is the same as the ground state of Al^{27}. The orbital moment $l = 2$ for all transitions, and with a positive parity $1/2 < I < 11/2$ for these levels. The rotational model of the Al^{27} nucleus is discussed, and a spin and parity of $(7/2)^+$ is assigned to the 2.22-Mev level in Al^{27}. (TTT)

22593 THE MEASUREMENT OF THE pγ-ANGULAR CORRELATION OF THE $Be^9(d,p\gamma)Be^{10}$ REACTION. G. A. Kosinov and O. F. Nemets. Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1518-20(Dec. 1962). (In Russian)

A Be^9 target having a thickness of 8 mg cm^{-2} was bombarded with 13.6-Mev deuteron beam from a cyclotron at the Ukrainian Institute of Physics. A fast coincidence circuit with a resolving time of $2\tau = 6 \times 10^{-9}$ sec was used to measure the p-γ coincidences from the $Be^9(d,p)Be^{10*}$ reaction. The resolving time for the slow coincidence circuit was 10^{-6} sec. The proton spectrometer (a 2 × 10 mm NaI crystal) was placed at an angle of 15° with respect to the direction of the deuteron beam. The angular correlation between the protons and γ rays is given by the following expression: $W(\theta) = 1 - (0.38 \pm 0.04)\ P_2(\cos\theta)$, where θ is the angle between the γ-counter and the direction of recoil. The ground state of Be^9 has a spin of $3/2$, and a negative parity. The first excited state of $Be^{10}(2^+)$ is formed during neutron capture with $l_n = 1$, and decays to a ground state O^+ by way of a pure E2 γ transition. An analysis of the p-γ correlation, with the assumption of L-S binding, gives a mixture of about 90% of spin 2 and 10% of spin 1 for the spin input channel. (TTT)

22594 THE e^--γ-COINCIDENCES DURING THE DECAY OF Pt^{188}. L. N. Kryukova, V. V. Murav'eva, N. V. Forafontov, and V. S. Shpinel (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1521-2(Dec. 1962). (In Russian)

A Pt^{188} sample was separated from the spallation products of gold irradiated with 660-Mev protons. The e^--γ coincidences were measured on a double-focusing β spectrometer which was hooked up to a scintillation γ spectrometer. The results showed that the 140, 380 and 410-kev γ rays, and the K x rays were in coincidence with the L55 conversion eleotrons. The intensity of the x rays in coincidence with the L55 electrons indicated the absence of K capture at the 55-kev level of Ir^{188} (and also at the upper 437- and 473-kev levels). The K195 conversion electrons made the principal contribution to the coincidences with the 280-kev γ rays. There were no coincidences between the 187- and 195-kev quanta. The K140 electrons were in coincidence with the 280-kev γ rays, and this indicated the presence of a cascade from the 470-kev level to the 195-kev level. The relative intensities of the γ lines were compared with those of the Nuclear Data Sheets, N3 (1959), and were found to be in good agreement. The ratio of the electron conversion coefficients at the K shell are as follows: $\alpha(K_{140}) : \alpha(K_{187}) : \alpha(K_{195}) : \alpha(K_{280}) : \alpha(L_{380}) : \alpha(K_{410}) : \alpha(K_{470}) = 0.5 : 1 : 1 : (<0.1) : (<0.03) : (<0.03) : (0.05)$. (TTT)

22595 THE GENETIC RELATION BETWEEN THE ISOMERIC STATES OF Ho^{160}. E. P. Grigor'ev, G. S. Novikov, and V. O. Sergeev (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1523-4(Dec. 1962). (In Russian)

An attempt was made to prove that the 4.7-hr activity of Ho^{160} goes through the isomeric state which has a half life of 28 min. If Ho^{160*} ($T_{1/2}$ = 4.7 hrs) → Ho^{160} ($T_{1/2}$ = 28 min), the 728-kev γ ray of Dy^{160} will grow in more slowly if the parent activity Er^{160} is first separated from the holmium activities. Thus, a γ spectrum of a Er^{160} + Ho^{160} mixture in equilibrium with others was taken on a scintillation γ spectrometer. The two isomers Ho^{160}($T_{1/2}$ = 28 min) and Ho^{160*}($T_{1/2}$ = 4.7 hr) were also in equilibrium with each other. Then, the erbium was chromatographically separated from the holmium, and measurements were started 11 minutes after the separation. It was found that the 728-kev γ transition of Dy^{160} does not follow directly after the decay of the 4.7-hr holmium activity, but the half life of the ground state of Ho^{160} could not be determined from the available data. (TTT)

22596 THE QUASI-ALPHA-PARTICLE MECHANISM OF THE PHOTOSPLITTING OF CARBON. V. N. Fetisov (Lebedev Inst. of Physics, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 26: 1525-6(Dec. 1962). (In Russian)

The cross section for the $C^{12}(\gamma,p)Be^{11}$ reaction was calculated on the assumption of an α-particle association in the C^{12} nucleus. The experimental cross section for the $He^4(\gamma,p)H^3$ reaction was used in the calculations. The sum of the partial (γ,p) cross sections for each quasi-alpha particle was multiplied by the probability of proton emission and triton capture of Be^8 to obtain the contribution of the quasi-alpha particles to the total cross section of a (γ,p) reaction on C^{12}. A comparison of the calculated results with experimental values shows that the interaction of γ quanta with the quasi-alpha particles is the main contribution to the cross section of the $C^{12}(\gamma,p)Be^{11}$ reaction at gamma energies of 30 to 60 Mev. At higher gamma energies, the quasi-alpha particle mechanism gives way to a two-nucleon mechanism. (TTT)

22597 RELATIVISTIC COULOMB SCATTERING. Bernard Rosen (Stevens Inst. of Tech., Hoboken N. J.). J. Math. Phys. (N. Y.), 4: 392-404(Mar. 1963).

Contour integration is employed to evaluate analytically the angular dependence of the relativistic correction terms to the Rutherford cross section for the scattering of electrons by nuclei at high energies. The phase shifts obtained by Mott from the solution of the Dirac equation are expanded in powers of the fine structure constant, and the resulting infinite sums are converted into integrals in the complex angular-momentum plane. In turn, these integrals are evaluated by distorting the path of integration and by the use of integral representations. In this manner, the angular dependence of the cross section is obtained in closed form up to terms of the fifth order in the cross section. The form of the correction term corresponding to an arbitrary power of the fine structure constant is found in terms of two-dimensional integrals involving elementary transcendental functions. A related problem, the nonrelativistic scattering for an attractive $1/r^2$ potential is also discussed. (auth)

22598 YIELD DETERMINATION OF THE THRESHOLD REACTIONS Ti(n,p)Sc AND Ge(n,α)Zn IN WATER-COOLED AND MODERATED REACTORS. S. Niese, P. Morzek, and C. Herold (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 37-9(Jan. 1963). (In German)

By using a γ-spectrometric absolute method the following effective cross sections were determined in the Rossendorf Reactor WWR-S: $Ti^{46}(n,p)Sc^{46}$, 17 ± 3 mb; $Ti^{47}(n,p)Sc^{47}$, 18 ± 3 mb; $Ti^{48}(n,p)Sc^{48}$, 0.44 ± 0.08 mb; $Ge^{72}(n,\alpha)Zn^{69m}$, 0.020 ± 0.005 mb; and $Ge^{74}(n,\alpha)Zn^{71m}$, 0.002 ± 0.001 mb. (tr-auth)

22599 CALCULATION OF URANIUM–WATER LATTICE EFFECTIVE CROSS SECTIONS. G. Bessner, W. Macke, and G. Opitz (Technische Universität, Dresden). Kernenergie, 6: 55-63(Feb. 1963). (In German)

By Westcott for well-moderated thermal reactors (D_2O or graphite moderator) effective, that is, averaged over the reactor spectra, cross sections were calculated, which are yielded by the conventional neutron flux and the reaction rate. The reactor cross sections of the nuclides Mn^{55}, Co^{59}, Au^{197}, U^{233}, U^{235}, U^{238}, Pu^{240}, Rh^{103}, and In^{115} could also be used in the investigated spectra of U-H_2O lattices. Variations resulted from that for Sm(3.2%) Pu_a^{239}(–1.0%), Pu_f^{239}(–0.8%), and Pu_f^{241}(–0.8%). Because of uncertain constants E_m and λ for effective cross section maximum errors of 3.3% for Sm and about 2% for the plutonium isotopes originated. The s-factors published by Westcott for the nuclide In^{115} at 40 and 80°C were corrected. (tr-auth)

22600 PION ABSORPTION IN HYDROGENOUS SUBSTANCES. V. I. Petrukhin and Yu. D. Prokoshkin (Joint Inst. for Nuclear Research, Dubna, USSR). Nuovo Cimento (10), 28: 99-106(Apr. 1, 1963). (In English)

The transfer process from hydrogen to other nuclei for negative pions stopped in hydrogenous substances is investigated. The probability of negative pion capture by the bound hydrogen nucleus reduces sharply with an increase of Z of the neighboring nucleus. (auth)

22601 ENERGY-LEVEL CORRECTIONS AND TRANSITION PROBABILITIES IN DEFORMED EVEN-EVEN NUCLEI. A. Covello and G. Vaccaccio (Istituto Nazionale di Fisica Nucleare, Naples and Università, Naples). Nuovo Cimento (10), 28: 191-6(Apr. 1, 1963). (In English)

The rotation-vibration interaction in deformed even-even nuclei is investigated, particularly the possibility of interpreting deviations from the one-parameter law for the energy of rotational levels in the ground band as results of such interactions. Coefficients of vibrational interactions are introduced as free parameters, and corrections to the energy levels and the transition probabilities as functions of parameters describing coupling between bands are calculated. (D.C.W.)

22602 (p-pd) REACTION. Y. Sakamoto (National Research Council, Ottawa). Nuovo Cimento (10), 28: 206-9 (Apr. 1, 1963). (In English)

Investigation of the high momentum components of nucleons in a nucleus by observing coincidences between the scattered proton and the knocked-out deuteron in (p,pd) reactions and comparing the results with known p-d elastic scattering is examined. Information about the two-nucleon correlation function is obtained in this manner. The angular correlation distribution for the $Li^6(p,pd)He^4$ reaction is obtained. (D.C.W.)

22603 BINDING ENERGY OF $^{13}C_\Lambda$. A. Z. M. Ismail, I. R. Kenyon, A. W. Key, S. Lokanathan, and Y. Prakash (Oxford Univ.). Nuovo Cimento (10), 28: 219-20(Apr. 1, 1963). (In English)

The mean binding energy of $_\Lambda C^{13}$ is determined as (10.91 ± 0.31) Mev by analysis of three mesonic decays of hyperfragments. (D.C.W.)

22604 HYPERFINE AND ISOTOPIC STRUCTURE IN THE SPECTRUM OF PLUTONIUM. L. A. Korostyleva. Opt. Spectry. (USSR) (English Transl.), 14: 93-5(Feb. 1963).

The Pu^{239} – Pu^{240} isotopic shifts of 118 lines were measured between 3900 and 6900 Å. Of these lines, 51 had only isotopic structure and 67 had both isotopic and hyperfine structure. The observed shifts were positive in some cases and negative in others. The largest isotopic shift was about 0.480 cm^{-1} and the smallest, 0.027 cm^{-1}. On the basis of data on isotopic shift and hyperfine splitting, a preliminary classification of the plutonium spectrum was made. (auth)

22605 ENERGETICS OF CHARGED PARTICLE-INDUCED FISSION REACTIONS. H. C. Britt, H. E. Wegner, and Judith C. Gursky (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 129: 2239-52(Mar. 1, 1963). (LADC-5494)

Measurements with a semiconductor detector system and a two-dimensional analyzer have yielded information on the mass distributions and the details of the kinetic energy release from a series of charged particle-induced fission reactions. The fissioning compound nuclei range from thallium for which the mass distributions are symmetric, to plutonium for which the fission is predominantly asymmetric. In an intermediate region, the charged particle-induced fission of Ra^{226} yields comparable contributions of symmetric and asymmetric fission. The results are quantitatively consistent with a two-mode hypothesis for the fission process and indicate that within each mode the distance between the charge centers of the two fragments at the scission point is approximately the same for all mass divisions. The results show a lower total kinetic energy release from symmetric fission than from asymmetric fission, indicating that the distance between the charge centers at the scission point is about 10% greater for the symmetric mode than for the asymmetric mode. (auth)

22606 EFFECTIVE MAGNETIC FIELD AND GRADIENT OF ELECTRIC FIELD ACTING ON THE NUCLEUS OF Eu IN EUROPIUM IRON GARNET. G. Gilat and I. Nowik (Hebrew Univ., Jerusalem). Phys. Rev., 130: 1361-4 (May 15, 1963).

The internal effective magnetic field (H_{eff}) and the electric field gradient acting on europium nuclei in europium iron garnet were calculated. The nondiagonal matrix elements connected with the admixture of states produced by the exchange interaction give the main contribution to these fields. The temperature dependence of these fields is compared with the dependence of the magnetic moment of the ion as calculated by Wolf and Van Vleck. The effective magnetic field at 0°K turns out to be 7×10^5Oe, whereas, the electric field gradient at 0°K is eq/h = –555 Mc/sec per b. The paramagnetic correction for the internal magnetic field acting on the nucleus of Eu in the presence of an external magnetic field is also calculated as a function of temperature. At room temperature $H_{int} = 1.54\ H_0$. (auth)

22607 QUADRUPOLE ANTISHIELDING FACTORS OF IONS. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 130: 1423-5(May 15, 1963). (BNL-6616)

Values of the quadrupole antishielding factor γ_∞ were

calculated for the Mn^{2+}, Fe^{3+}, Ga^{3+}, and Ag^{+} ions, using the method of direct solution of the inhomogeneous Schrödinger equation for the perturbed wave functions. For the Fe^{3+} ion, the present value of $\gamma_\infty(=-9.14)$ is appreciably larger in magnitude than that previously obtained by Burns and Wikner, resulting in a decrease of the calculated quadrupole moment of Fe^{57m} as deduced from measurements using ferric compounds. The resulting value of $Q(Fe^{57m})$ is $+0.28 \times 10^{-24}$ cm^2. (auth)

22608 YIELDS AND HALF-LIVES IN THE MASS-99 FISSION-PRODUCT CHAIN. David E. Troutner, Robert L. Ferguson, and G. Davis O'Kelley (Oak Ridge National Lab., Tenn.). Phys. Rev., 130: 1466-70(May 15, 1963).

Half lives, fission yields, and genetic relationships of Zr, Nb, and Mo members of the mass-99 fission-product chain were studied by radiochemical methods. Evidence was obtained for a Nb^{99} isomer of half-life 10 ± 2 sec, which decays directly to Mo^{99} in at least 52% of its disintegrations. Attempts to observe gamma radiation from this isomer in rapidly separated niobium fission products were not successful. A half life of 2.3 ± 0.3 min was obtained for a known isomer of Nb^{99}, in good agreement with reported values. The fraction of the mass-99 fission product chain that passes through the longer-lived isomer was found to be ≤ 0.36. The cumulative fractional chain yield of both isomers was determined to be 0.95 ± 0.11, consistent with the predicted value of ~ 0.99. Although this result is not sufficiently precise to be a stringent test of the proposed preference in low-energy uranium fission for a 50–42 proton split, it does indicate that the maximum effect would be sufficient to distort the "normal" charge-distribution curve by an amount equivalent to approximately one charge unit. No evidence was found for 35-sec Zr^{99}, previously reported to be a fission product. If it occurs in fission, its cumulative fractional chain yield is ≤ 0.03, in contrast to the expected value of ~ 0.80. An upper limit of 1.6 sec was estimated for the half-life of Zr^{99}. (auth)

22609 NONELASTIC NEUTRON CROSS-SECTION MEASUREMENTS ON Li^6, Li^7, U^{235}, U^{238}, AND Pu^{239} AT 8.1, 11.9, AND 14.1 Mev. M. H. MacGregor, R. Booth, and W. P. Ball (Univ. of California, Livermore). Phys. Rev., 130: 1471-2(May 15, 1963). (UCRL-5217(Rev.1))

Ionelastic neutron cross sections were measured for Li^6, Li^7, U^{235}, U^{238}, and Pu^{239} at 8.1, 11.9, and 14.1 Mev by means of the sphere transmission technique. (auth)

22610 SEARCH FOR DELAYED-NEUTRON EMISSION IN Br^{86} DECAY. Ellis P. Steinberg and Larry L. Schwartz (Argonne National Lab., Ill.). Phys. Rev., 130: 1472-4(May 15, 1963). (TID-17873; UAC-7149)

A search for delayed-neutron activity in the decay of 54-sec Br^{86} was carried out. No statistically significant activity was observed, but an upper limit for the neutron branch of ~0.25% was set. This limit corresponds to a maximum of ~10% for the possible contribution of Br^{86} to the 55-sec delayed-neutron period observed in the thermal neutron fission of U^{235} and ascribed to Br^{87}. (auth)

22611 $C^{12}(He^3,n)O^{14}$ REACTION AT 19, 22, AND 25 Mev. J. H. Manley (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 130: 1475-81(May 15, 1963). (LADC-5253)

With the aid of neutron detectors having thresholds at 1, 5, and 12 Mev, the angular distributions and average cross sections of the $C^{12}(He^3,n)O^{14}$ reaction were investigated at 19-, 22-, and 25-Mev He^3 energy. All angular distributions show strong forward peaking suggestive of direct interactions. One case, involving only transitions to the ground state, exhibits a type of structure similar to that of protons from the $C^{12}(He^3,p)N^{14}$ reaction to the first excited state, the T = 1 analog of the O^{14} ground state. However, the momentum transfer at a reasonable radius is such that plane-wave theory would predict a minimum at 0° instead of the strong forward peak observed. (auth)

22612 ALPHA DECAY PROPERTIES OF SOME HOLMIUM ISOTOPES NEAR THE 82-NEUTRON CLOSED SHELL. Ronald D. MacFarlane and Roger D. Griffioen (Univ. of California, Berkeley). Phys. Rev., 130: 1491-8 (May 15, 1963).

Bombardment of Pr^{141} targets with 75 to 137-Mev O^{16} ions resulted in the identification of new alpha-emitting isotopes of holmium. Half-lives of the nuclides and energies of the emitted α-particles were obtained. Excitation functions were obtained for the production of these nuclides and for the production of Dy^{150}, Dy^{151}, and Dy^{152}. Large differences were observed for the energy dependence of the excitation functions of the isomer pairs that were attributed to angular momentum effects. Alpha branching ratios were estimated and used to calculate alpha reduced level widths. (auth)

22613 SIGN OF THE MIXING RATIO δ. L. Simons and I. Forsblom (Univ. of Helsinki). Phys. Rev., 130: 1499(May 15, 1963).

The sign of δ (the ratio of the reduced matrix element corresponding to multipole order L′ to that corresponding to multiple order L) is compared for s-wave protons in (p,γ,γ) and (γ,γ) correlations. In both cases, Lloyd's convention gives the proper sign of δ. (auth)

22614 $C^{12}(n,\alpha)Be^9$ REACTION INDUCED BY 14-Mev NEUTRONS. R. A. Al-Kital and R. A. Peck, Jr. (Brown Univ., Providence). Phys. Rev., 130: 1500-3(May 15, 1963). (TID-17029)

The reaction $C^{12}(n,\alpha)Be^9$ was studied with emulsions. Total cross section for the forward hemisphere (lab) and first 5-Mev excitation is 144 ± 57 mb, of which 62 ± 15 mb is associated with the ground-state group. These are consistent with earlier estimates, and with measured values for the inverse process. Angular distributions of the ground and 2.4-Mev excited state groups have the direct interaction form, and a spin of $^3/_2$ is indicated for the excited state. This value supports earlier arguments for LS coupling in Be^9 and suggests that the 2.4-Mev state consists of Be^8 in its first excited state and a p-state neutron. Comparison of the ratio of reduced widths, for transitions to the 0.0- and 2.4-Mev states, with an estimate of the ratio of the corresponding coefficients of fractional parentage, favors a knockout mechanism. (auth)

22615 DECAY ENERGY OF Tb^{161}. P. F. M. Koehler (George Washington Univ., Washington, D. C.), L. Slack, and N. B. Gove. Phys. Rev., 130: 1503-4(May 15, 1963).

The beta decay of 7.1-day Tb^{161} has been studied with a double-focusing magnetic spectrometer. The end point of the highest beta group was found to be 584 ± 6 kev. (auth)

22616 BREMSSTRAHLUNG FROM PROTON BOMBARDMENT OF NUCLEI. David Cohen, Burton J. Moyer, Harlan C. Shaw, and Charles N. Waddell (Univ. of California, Berkeley). Phys. Rev., 130: 1505-11(May 15, 1963). (UCRL-10106)

Various targets were bombarded with 38 to 185-Mev protons. Photons from these targets were viewed at experimentally available angles from the proton beam with a 180-deg pair spectrometer capable of detection in the photon energy range of 8 to 150 Mev. The accumulated spectra above 20 Mev, after subtraction of some π^0 photon contamination, are assumed to be due to proton brems-

strahlung. The general spectral features are explained in terms of electric-dipole radiation from p-n collisions, where the target neutrons are in motion. The detailed features are discussed in terms of the available theoretical predictions; there is good agreement with the phenomenological calculation using n-p scattering data. (auth)

22617 EXCITATION FUNCTIONS OF REACTIONS OF 7- TO 24-Mev He^3 IONS WITH Cu^{63} AND Cu^{65}. E. A. Bryant, D. R. F. Cochran, and J. D. Knight (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 130: 1512-22(May 15, 1963). (LADC-5593)

Excitation functions of the (He^3,p), (He^3,n), (He^3,2p), (He^3,p2n), (He^3,p3n), (He^3,α), (He^3,αn), and (He^3,2α) reactions on Cu^{63} and the (He^3,n), (He^3,2n), (He^3,p2n), (He^3,3n), and (He^3,αp) reactions on Cu^{65} were measured at incident He^3 energies from 7 to 24 Mev. It is shown that the He^3 excitation functions are comparable to those of the analogous He^4 reactions. Computed cross sections based on the compound-nucleus evaporation model are in qualitative agreement with observed values for both He^3 and He^4 reactions. (auth)

22618 (p,n) CROSS SECTIONS AT 6.75 Mev. R. M. Humes, G. F. Dell, Jr., W. D. Ploughe, and H. J. Hausman (Ohio State Univ., Columbus). Phys. Rev., 130: 1522-4 (May 15, 1963).

The (p,n) partial reaction cross sections at 6.75 Mev were measured for the isotopes Sc^{45}, V^{51}, Mn^{55}, Cu^{63}, Cu^{65}, Ga^{69}, Ga^{71}, and Br^{79}. The results of the measurements in millibarns are 179 ± 9, 480 ± 31, 440 ± 40, 239 ± 13, 566 ± 37, 981 ± 98, 649 ± 69, and 86 ± 5, respectively. The purpose of the experiment is to provide information on reaction cross sections for comparison with optical-model computations. A preliminary comparison of the variation of the cross sections with mass number is made with the partial wave penetrabilities computed from an optical-model potential. (auth)

22619 STRONG M1 TRANSITIONS IN LIGHT NUCLEI. Dieter Kurath (Argonne National Lab., Ill. and Univ. of Washington, Seattle). Phys. Rev., 130: 1525-9(May 15, 1963). (TID-18362; UAC-7193)

The nature of strong M1 transitions, particularly those observed by inelastic electron scattering at backward angles, is investigated. Calculations of particular cases reveal a tendency to concentrate the transition strength in a few levels, in some respects similar to the familiar giant E1 resonance. The energy-weighted sum rule for such transitions is examined, and an approximation is developed that exhibits the qualitative behavior to be expected in 4N nuclei whose ground states have I = 0 = T. The results are compared with experiment. (auth)

22620 NITROGEN-14 AND THE SHELL MODEL. William W. True (Univ. of California, Davis and Univ. of California, Berkeley). Phys. Rev., 130: 1530-7(May 15, 1963). (UCRL-10663)

A shell-model calculation was done of the lower lying levels of N^{14} under the assumption that the C^{12} nucleus forms an inert core about which two nucleons can move in $1p_{1/2}$, $2s_{1/2}$, $1d_{5/2}$, or $1d_{3/2}$ orbitals. It was possible to give shell-model assignments to practically all of the observed levels in N^{14} below 10.50 Mev, and these assignments are in good agreement with the experimental data and with other theoretical calculations. Several levels not predicted by this model are expected to arise from the excitation of $1p_{3/2}$ particle(s) out of the C^{12} core into higher orbitals. (auth)

22621 NUCLEAR STRUCTURE EFFECTS IN HIGH-ENERGY (p,pn) REACTIONS. Norbert T. Porile and Shigeo Tanaka (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 130: 1541-8(May 15, 1963). (BNL-6603)

Cross sections for the (p,pn) reaction of Cu^{65}, Zn^{66}, Ge^{70}, Ge^{72}, Se^{76}, Br^{79}, and Br^{81} were measured at 2.9 Bev. The following variation with target neutron number is indicated by these results, as well as by recent measurements for Ga^{69}, Ga^{71}, and As^{75}: The (p,pn) cross sections increase from 50 mb at N = 36 to 64 mb at N = 40, then decrease to 48 mb at N = 42, and finally increase to 59 mb at N = 46. The results are compared with Benioff's calculation of (p,pn) cross sections, and good agreement is obtained on the assumption that the $1f_{5/2}$ shell is available for the (p,pn) reaction up to N = 40 and unavailable thereafter. The effect of nuclear deformation on the availability of this shell is considered in detail and is found to be small. (auth)

22622 BRANCHING RATIOS OF REACTIONS OF π^- MESONS STOPPED IN HYDROGEN AND DEUTERIUM. James W. Ryan (Univ. of California, Berkeley). Phys. Rev., 130: 1554-67(May 15, 1963). (UCRL-9884(Rev.))

The Panofsky ratio $P = \omega(\pi^- + p \rightarrow \pi^0 + n)/\omega(\pi^- + p \rightarrow \gamma + n)$ and the branching ratio $S = \omega(\pi^- + d \rightarrow n + n)/\omega(\pi^- + d \rightarrow \gamma + n + n)$ were measured by stopping π^- mesons in liquid hydrogen and liquid deuterium and detecting the γ rays produced. A high-resolution γ-ray spectrometer of the 180-deg-focusing type is employed. Sixty-six Geiger tubes and nine scintillation counters are used in the spectrometer to define the electron-positron orbits, providing an intrinsic instrument resolution of 0.8%. The values obtained for the branching ratios are P = 1.51 ± 0.04 and S = 3.16 ± 0.12. This value for P is in good agreement with that obtained in previous measurements, while the value for S is significantly larger than previous results. With regard to the conventional phenomenological analysis of S-wave pion physics, the Panofsky ratio is in good agreement, whereas the value obtained in this experiment for the branching ratio S is considerably larger than predicted. (auth)

22623 VOLUME PROPERTIES OF GROUND-STATE NUCLEAR MATTER. John C. Reynolds (Argonne National Lab., Ill.) and Robert D. Puff. Phys. Rev., 130: 1877-90(June 1, 1963). (TID-18182; UAC-7117)

An approximation for treating macroscopic bound systems in the ground state is applied to a homogeneous system of nuclear matter using a simple separable potential. More extensive numerical results are given for the density, energy density, chemical potential, effective potential, momentum distribution, pressure, and density correlation function. In addition, an ambiguity in the calculation of the pressure arising directly from the approximation is discussed. This ambiguity and its effect on the nuclear parameters at the physically meaningful point of zero pressure is treated in detail. In particular, three different expressions for the pressure are derived that lead to zero-pressure values of −14.4, −17.0, and −17.5 Mev for the binding energy/particle and 0.87, 0.95, and 1.01 F for the interparticle spacing. A numerical examination of the density correlation function suggests, as expected, that correlations of more than two particles are rare at nuclear densities. (auth)

22624 SURFACE PROPERTIES OF GROUND-STATE NUCLEAR MATTER. John C. Reynolds (Argonne National Lab., Ill.). Phys. Rev., 130: 1891-1901(June 1, 1963). (TID-18183; UAC-7135)

A general method is derived for extending the many-body formalism of Martin and Schwinger to macroscopic inhomogeneous systems. This method is applied to the Puff-Martin approximation for nuclear matter and used

to compute the properties of a plane nuclear surface. An iterative self-consistency computation is used, and a generalized effective-mass approximation is imposed to simplify the wave equation. The particle interaction is taken to be a separable Yamaguchi potential with an S-state hard shell. The results show a smoothly varying density and self-energy, with a surface thickness of 2.33 F. A calculation of the surface energy term in the Weizsäcker semiempirical mass formula gives 18.79 Mev. (auth)

22625 ANGULAR CORRELATIONS OF CASCADE GAMMA RAYS IN THE DECAY OF Lu^{172}. Margaret M. Stautberg, E. Brooks Shera, and Karl J. Casper (Western Reserve Univ., Cleveland). Phys. Rev., 130: 1901-6 (June 1, 1963).

Angular correlation experiments were performed on the 1095–78.7, 901–1095, 901–78.7, and 1586–78.7 kev γ ray cascades in Lu^{172}. The results of the directional correlation and polarization correlation measurements on the 1095–78.7 kev gamma rays establish the spin and parity of the 1174-kev excited state as 3+. The other measurements are consistent with previous assignments for the spins and parities of the 1664 and 2075-kev excited states. (auth)

22626 SPIN DEPENDENCE OF THE THERMAL NEUTRON CROSS SECTION OF Co^{59}. R. I. Schermer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 130: 1907-13(June 1, 1963). (BNL-6635)

Transmission experiments were carried out with polarized, monochromatic neutrons and polarized Co^{59} nuclei using a polycrystalline sample of cobalt metal. By studying the transmission as a function of temperature and neutron energy, the effects of magnetic and nuclear scattering may be separated, and the spin dependence of both the capture and scattering cross sections determined. It is found that $(78.3 \pm 1.0)\%$ of the thermal capture is into $I + \frac{1}{2} = 4$ states, the remainder being into $I - \frac{1}{2}$ states. This establishes the contribution of a bound level to the thermal cross section. The scattering cross section is $(87 \pm 1)\%$ due to $I - \frac{1}{2}$ states. These results are discussed in terms of the resonance structure of Co^{59}. (auth)

22627 COLLECTIVE EXCITATIONS IN $Ni^{58,60,62}$ AND $Zn^{64,66,68}$. H. W. Broek (Argonne National Lab. Ill.). Phys. Rev., 130: 1914-25(June 1, 1963). (TID-18188; UAC-7148)

Collective levels in $Ni^{58,60,62}$ and $Zn^{64,66,68}$ were studied by inelastic scattering of 43-Mev alpha particles. The relative strengths of the 2^+ first excited level are proportional to values of β_2^2 for isotopes of the same element. The ratio of strength to β_2^2 shows no significant variation with N for the nuclei studied, but is strongly dependent upon Z. Probable two-phonon triplets can be identified in Ni^{60} and Ni^{62}. The two-phonon groups in $Ni^{58,60,62}$ reach maxima in their angular distributions about 0.2 cycle later than in elastic scattering, while the two-phonon groups in $Zn^{64,66,68}$ reach the maxima 0.2 cycle earlier than in elastic scattering. Thus, the two-phonon groups from Ni are out of phase with those from Zn. A proposed scheme of two-phonon levels is given. Levels with three-phonon properties are found near 3.24 Mev in Ni^{62} and probably near this energy in Ni^{58} and Ni^{60}. The cross section for the 3^- collective level is about 1.8 times as large in Zn as in Ni, and varies rather slowly with neutron number. It is likely that the 3^- collective levels in Zn contain a large proportion of configurations with two unpaired protons. In all six targets groups were seen in the energy range expected for combination frequencies of a 3^- phonon and a 2^+ phonon. A possible second 3^- level was seen in all six targets at slightly more than 1.5 times the energy of the first 3^- collective level. (auth)

22628 REACTION $Zr^{90}(n,n')Zr^{90m}$. Robert T. Wagner, E. R. Shunk, and Robert B. Day (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 130: 1926-30(June 1, 1963). (LADC-5595)

The cross section for the excitation of the 2.3-Mev metastable state in the $Zr^{90}(n,n)Zr^{90m}$ reaction was measured from threshold to 5 Mev. An irradiated-count cycle was used in which a Zr sample was first bombarded by monoenergetic neutrons and then transferred by a pneumatic transport system to a shielded counting station where the 2.3-Mev gamma rays from the decay of the metastable state were measured. The half life of this state was found to be $T_{\frac{1}{2}} = 0.801 \pm 0.005$ sec. The excitation curve has a threshold at 2.3 Mev and increases monotonically to 300 mb at 5 Mev. In addition to the threshold rise there are also marked increases in cross section that begin at 2.75 and 4.4 Mev. These increases are due to states at these energies that cascade through the 2.3-Mev state. The state at 2.75 Mev is probably the hitherto missing 4– state of the $(p_{\frac{1}{2}}g_{\frac{9}{2}})$ configuration and it is essentially equal to the 3– state at 2.75 Mev that was observed in other reactions. (auth)

22629 NUCLEAR PROPERTIES OF $_{25}Mn^{55}$ (SEMI-ATOMIC MODEL). Y. F. Bow (Michigan State Univ., East Lansing). Phys. Rev., 130: 1931-47(June 1, 1963).

The nuclear properties of Mn^{55} and some other nuclei in the region of $(1f_{\frac{7}{2}})$ shell are investigated in detail by using a new model that is essentially an extremely weak-coupling formulation of the unified model in contrast to the semimolecular formulation of Bohr and Mottelson. By restricting the variation range of the deformation variable γ to the interval $0 \leq \gamma < \pi/3$, a zero-point surface-particle interaction that does not exist in the usual weak-coupling theory is naturally introduced. The theoretical basis for this interaction and the problem of the range of γ are discussed. A theoretical relation for the magnetic moment ratio of two odd-A nuclei with conjugate configurations is tested in the region of the $(1f_{\frac{7}{2}})$ shell. The theoretical predictions are in good agreement with the experimental results. An explanation for the positive-negative asymmetry of the quadrupole moment distribution of odd-4 nuclei is suggested. It seems that this asymmetry was so far overlooked without explanation. The E2 reduced transition probability in the semiatomic model is given. The calculated E2 reduced transition probability for V^{51} in the transition $J_0 = \frac{5}{2} \rightarrow J = \frac{7}{2}$ is in excellent agreement with the value from Coulomb excitation measurements. (auth)

22630 SOME REGULARITIES OF THE MAGNETIC MOMENT DISTRIBUTION OF ODD-A NUCLEI. Y. F. Bow (Michigan State Univ., East Lansing). Phys. Rev., 130: 1947-52(June 1, 1963).

Some systematic features of the magnetic moment distribution of odd-A nuclei are established and theoretical explanation for them is given. The explanation suggested is based on the idea of quenching of the intrinsic magnetic moments of nucleons in nuclei. This idea was created independently by several investigators many years ago and was re-examined in detail recently. Essentially all these investigations predict that the magnetic moment of an odd-A nucleus should be somewhere between the so-called Schmidt and Dirac limits. However, if the exclusion principle is the only reason for the quenching, the magnitude of the quenching turns out to be too small to explain the large magnetic moment deviations from the Schmidt limit. Therefore, the question is whether this idea is valid or

whether, even if it is valid, other factors such as configuration mixing, core excitation, etc., are more important. These questions are attacked empirically. Furthermore, it is shown that the parity rule may also be an important factor in quenching the intrinsic magnetic moments of nucleons in nuclei. (auth)

22631 ALPHA-PARTICLE EMISSION IN THE DECAYS OF B^{12} AND N^{12}. D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.), D. E. Alburger, A. Gallmann, and P. F. Donovan. Phys. Rev., 130: 1953-60(June 1, 1963). (BNL-6625)

Alpha particles following the beta decay of B^{12} and the positron decay of N^{12} to the region of C^{12} above the 7.66-Mev state were observed using a solid-state counter. The two alpha-particle spectra differ considerably in form and intensity but are completely consistent with one another within the assumption of charge symmetry. Since transitions to a possible admixed T = 1 component in C^{12} would be coherent with those to the chief T = 0 component and since the matrix elements to these two components add in one decay and subtract in the other, the test of charge symmetry is quite sharp and it is shown that the intensity of the T = 1 impurity may well be less than 1%. The branching ratios for the production of these high-energy alpha particles are $(7 \pm 2) \times 10^{-4}$ and $(4.4 \pm 1.5) \times 10^{-3}$ in the decay of B^{12} and N^{12}, respectively. A reasonable account of the alpha-particle spectrum following N^{12} decay (and so, by implication, following B^{12} decay) is given by a single very broad $J = 0^+$ level at a nominal resonance energy of 5.0 Mev above $Be^8 + \alpha$ and a reduced width of 2.6 single-particle units. A better account is given by a broad level at lower excitation plus a level at about 11.8 Mev to which the N^{12} beta decay has log ft ≈ 4.6. The possible origin of the alpha-particle spectra in terms of the ghost of the 7.66-Mev state is considered and it is concluded that while such an effect may be quite considerable it is unlikely to account for the whole spectra as observed. (auth)

22632 DECAY OF Ni^{56}. D. O. Wells, S. L. Blatt, and W. E. Meyerhof (Stanford Univ., Calif.). Phys. Rev., 130: 1961-70(June 1, 1963).

The radioactive decay of Ni^{56} to Co^{56} (half life, 6.10 ± 0.02) was investigated using scintillation gamma-ray spectrometers, both singly and in coincidence. The seectra revealed gamma rays of 0.164 ± 0.003(99.3 ± 6.6), 0.272 ± 0.004(31.5 ± 5.2), 0.484 ± 0.004(34.6 ± 2.0), 0.755 ± 0.003(48.0 ± 3.2), 0.820 ± 0.003(84.9 ± 8.3), 0.982 ± 0.010(1.2 ± 1), and 1.57 ± 0.01(14.1 ± 0.9) Mev. The intensities of the gamma rays (number per 100 decays) appear in parentheses. The data were consistent with an upper limit of 1 per 100 decays for the intensity of any positron emission. Coincidence spectra, angular-correlation measurements, and delayed-coincidence measurements permitted the construction of a decay scheme with energy levels at 0.00(4^+), 0.164(3^+), 0.984(2^+), 1.47(1^-,2^+), and 1.74(1^+) Mev. The level scheme is compared with other recent work concerning the energy levels of Co^{56}. (auth)

22633 GAMMA RAYS FROM LITHIUM BOMBARDMENT OF Be^9, B^{10}, B^{11}, AND C^{12}. E. Norbeck, S. A. Coon, R. R. Carlson, and E. Berkowitz (State Univ. of Iowa, Iowa City). Phys. Rev., 130: 1971-86(June 1, 1963).

Relative intensities of gamma rays produced in the bombardment of Be^9, B^{10}, B^{11}, and C^{12} targets by Li^6 and Li^7 beams were obtained with a three-crystal pair spectrometer and with a single NaI(Tl) crystal. Gamma rays were observed from excited states in the residual nuclei Li^7, Be^{10}, B^{10}, B^{11}, B^{12}, C^{12}, C^{13}, C^{14}, N^{14}, N^{15}, O^{15}, O^{16}, and O^{17}. Some of these gamma rays were not observed previously. Relative populations deduced from the data are discussed. (auth)

22634 EXCITATION FUNCTIONS FOR NUCLEAR REACTIONS BETWEEN COMPLEX NUCLEI. I. NEUTRON EMISSION. G. R. Choppin and T. J. Klingen (Florida State Univ., Tallahassee). Phys. Rev., 130: 1990-5(June 1, 1963).

The excitation functions were determined for the formation of Ce^{134}, Ce^{135}, and Ce^{137m} by the reactions $Te^{128} + C^{12}$, $Te^{130} + C^{12}$, and $Sn^{124} + O^{16}$. The maximum cross sections were less than 0.6 b for all the reactions studied. The excitation functions appear to be displaced by 10 to 15 Mev higher in energy than expected for compound nucleus formation reactions of low angular momentum. This energy shift agrees with the extra energy measured by two other different techniques for the same Te + C system. This agreement provides good evidence that the effect of high angular momentum is to decrease de-excitation by neutron emission relative to that by gamma emission. (auth)

22635 EXCITATION FUNCTIONS FOR NUCLEAR REACTIONS BETWEEN COMPLEX NUCLEI. II. CHARGED PARTICLE EMISSION. T. J. Klingen and G. R. Choppin (Florida State Univ., Tallahassee). Phys. Rev., 130: 1996-9(June 1, 1963).

The production of La^{135}, Ba^{135m}, and Ba^{133m} from the nuclear reactions of $Te^{128} + C^{12}$, $Te^{130} + C^{12}$, and $Sn^{124} + O^{16}$ was measured radiochemically. The function of La^{135} appears to occur by nucleon evaporation following compound nucleus formation. The maximum cross section is consistent with this picture when compared to the maximum cross section for Ce^{135} formation. The maximum cross section for the formation of the barium isotopes is much greater than for formation of the lanthanum and cerium isobars. This would seem to suggest a direct-interaction mechanism for alpha particle emission. (auth)

22636 ALPHA DECAY TO VIBRATIONAL STATES. S. Bjoernholm, M. Lederer, F. Asaro, and I. Perlman (Univ. of California, Berkeley). Phys. Rev., 130: 2000-10 (June 1, 1963). (UCRL-9938)

A coincidence apparatus was developed that permits the measurement of energies and intensities of rare alpha groups leading to excited states of the product nucleus. It proved possible to measure transitions with intensities as low as 10^{-8}, and the technique was used to characterize vibrational states. The energies, relative abundances, and multipole orders of the gamma ray and conversion electron transitions that de-excite the levels populated by these weak alpha branchings can be determined, and these lead to assignments of spin and parity for the levels. Excited states with spin and parity 0+ were confirmed in the energy level spectrum of Th^{230}, U^{234}, Pu^{238}, and Pu^{240}. A corresponding state was observed at 780 kev in the energy level spectrum of U^{235} and was given the assignment $\frac{1}{2}^+$. The reduced alpha transition probabilities to states of this type were found generally to be about an order of magnitude smaller than the theoretical value for unhindered alpha decay. The characterization of these levels simply as beta vibrations appears to be inadequate in that there are distinct differences in the modes of de-excitation for the different nuclides. (auth)

22637 MEASUREMENT OF THE Pb M PHOTON INTENSITY IN Po^{210} DECAY — A FURTHER GROSS INADEQUACY OF THE THEORY. William Rubinson (Brookhaven

National Lab., Upton, N. Y.). Phys. Rev., 130: 2011-21 (June 1, 1963).

The probability that a Pb M photon is emitted in Po^{210} decay is $0.91(\pm 15\%) \times 10^{-3}$ photons/alpha, as measured by means of a proportional counter and pulse-height analyzer. This value is in gross disagreement with theoretical estimates. A Pb M spectrum from Po^{210} decay shows definite differences from a conventional Pb M spectrum, indicating considerable ejection of higher shell electrons in the Po^{210} decay act. In particular, the spectrum from Po^{210} contains a 3.7-kev component whose intensity is about 4% of the total spectral intensity and whose energy is consistent with the allowed, but hitherto unreported, transition M_1O_{23}. The theory of electron ejection in alpha decay is reviewed and previous calculations of ejection probabilities are extended to include ejection to bound states. The estimates of K, L, and M photon yields on this theory are orders of magnitude lower than the measured yields. Possible sources of the discrepancy are discussed. (auth)

22638 $Ni^{58}(n,p)Co^{58m,g}$ CROSS SECTION AND ISOMER RATIO FROM 1.04 TO 2.67 Mev. J. W. Meadows and J. R. Whalen (Argonne National Lab., Ill.). Phys. Rev., 130: 2022-5(June 1, 1963). (TID-18366)

The cross sections and isomer ratios for the $Ni^{58}(n,p)Co^{58m,g}$ reaction were measured relative to the $U^{235}(n,f)$ reaction for neutron energies of 1.04 to 2.67 Mev. The absolute yield of Co^{58} was determined by counting coincidences between the 0.800-Mev γ ray and the annihilation radiation of the positrons from the decay of the Co^{58} ground state. The observed cross sections and isomer ratios are compared with calculated values obtained by assuming compound nucleus formation and proton emission only to the 5+ and 2+ states of Co^{58}. (auth)

22639 ELASTIC SCATTERING OF PROTONS FROM Li^6 NUCLEI. J. A. McCray (California Inst. of Tech., Pasadena). Phys. Rev., 130: 2034-42(June 1, 1963).

The differential elastic scattering cross section for protons from Li^6 nuclei was measured for proton energies from 0.45 to 2.9 Mev at six different angles. The scattering data are consistent with an s and p-wave phase shift analysis, assuming a single p-wave $5/2^-$ state to be present at about $E_p(lab) = 1.84$ Mev, with resonance parameters similar to the parameters previously assigned to the corresponding level in Li^7, and a very broad s-wave $1/2^+$ state at higher energy. It is also possible to fit the scattering and reaction data with a p-wave $3/2^-$ state and a different choice of s-wave background. A p-wave $1/2^-$ state is not consistent with the data. No evidence was found for the existence of a previously reported $3/2^+$ state near $E_p(lab) = 1$ Mev. Removal of the simplifying assumption that only one p-wave state is participating would probably lead to different conclusions about the nature of the s-wave scattering. The relative stopping cross section for protons in lithium was also measured and found to follow the Bloch formula from 0.8 to 2.8 Mev. (auth)

22640 NEW ISOMERS OF ASTATINE-212. W. Barclay Jones (Univ. of California, Berkeley). Phys. Rev., 130: 2042-3(June 1, 1963). (UCRL-10645)

The $Bi^{209}(\alpha,n)At^{212}$ reaction was investigated in the energy range of 17 to 25 Mev. Astatine-122 was observed to decay by alpha-particle emission. An alpha group of 7.60 and 7.66 Mev having a half life of 0.305 sec and another group of 7.82 and 7.88 Mev having a half life of 0.120 sec were observed. Relative excitation functions were obtained for both isomers. An energy-level diagram for the alpha decay of astatine-212 is proposed. (auth)

22641 FRAGMENT KINETIC ENERGY RELEASE IN HEAVY-ION INDUCED FISSION REACTIONS. Victor E. Viola, Jr. and Torbjoern Sikkeland (Univ. of California, Berkeley). Phys. Rev., 130: 2044-53(June 1, 1963). (UCRL-10284)

The most probable kinetic-energy release in fission reactions induced by 125-Mev C^{12} ions and 166-Mev O^{16} ions was measured for the target nuclei Pr^{141}, Tb^{159}, Ho^{165}, Tm^{169}, Lu^{175}, Au^{197}, Bi^{209}, Th^{232}, U^{238}, and Pu^{240}. Silicon diode surface-barrier detectors were used in these measurements, and a Cf^{252} spontaneous-fission source served as the absolute energy standard. A least-squares analysis of the data and those obtained by others gives $\bar{E}_K(Mev) = 0.1065\ Z^2/A^{1/3} + 20.1$. The dependence of the most probable kinetic energy on the scission shape of the fissioning nucleus was examined by comparison with recent calculations based on the work of Cohen and Swiatecki. The data are consistent with scission shapes corresponding to spheroids whose shapes minimize the total energy of the system. The most probable kinetic-energy release was found to be essentially independent of the excitation energy of the compound nucleus. It is also observed that the full width at half-maximum of the kinetic-energy distribution is relatively constant for values of the fissionability parameter x less than 0.7, but increases rapidly above this value. The halfwidth also exhibits an increased spread as the excitation energy of the compound nucleus increases. (auth)

22642 CALCULATION OF DEUTERON STRIPPING AMPLITUDES USING S-MATRIX REDUCTION TECHNIQUES. Alvin M. Saperstein (Argonne National Lab., Ill.). Phys. Rev., 130: 2054-60(June 1, 1963). (TID-18373; UAC-7192)

The transition matrix for deuteron stripping is calculated by use of the Lehmann, Symanzik, and Zimmerman technique for S-matrix reduction. The interaction is assumed to occur via two-body local potentials and all terms are retained in order to give insight into the difference between direct and indirect interactions. In the direct interaction approximation, it is shown that the stripping amplitude can be expressed in terms of a source term and the phase shifts for elastic scattering of deuterons and nucleons incident, respectively, on the initial and final nuclei. The source term includes the usual Born approximation as well as other terms arising from the identity of nucleons. (auth)

22643 ELECTRODISINTEGRATION OF H^3 AND He^3. Ronald McClure Haybron (Case Inst. of Tech., Cleveland). Phys. Rev., 130: 2080-8(June 1, 1963).

The electrodisintegration cross section for 400-Mev electrons on H^3 and He^3 were calculated using the Born approximation for the motion of the electrons and allowing both nucleon-deuteron and three-nucleon disintegrations. The contributions due to these two processes were found to be comparable for both nuclei, assuming the processes to be uncoupled. The cross sections for both processes were found to be essentially the sum of the cross sections for elastic scattering off the free fragments multiplied by a function characterizing the momentum distribution of the fragment in the ground state of the target nucleons. The effects of the final-state interactions between the fragments were considered and found to reduce the cross sections appreciably relative to the result obtained by neglecting these interactions. (auth)

22644 HIGHER ORDER CORRECTIONS TO THE COHERENT PRODUCTION OF VECTOR BOSONS IN THE COULOMB FIELD OF A NUCLEUS. M. Veltman (CERN, Geneva). Physica, 29: 161-85(Mar, 1963). (In English)

The wave function for a vector boson in a Coulomb field is obtained in a high energy approximation. The Furry wave function for a lepton in a Coulomb field is reconsidered and extended by taking into account a term hitherto neglected. Both wave functions are then applied to the coherent production of vector bosons and muons by neutrinos in the Coulomb field of a nucleus. For low-energy muons the matrix element is improved by taking into account all second order effects for the muon. The effect of nuclear structure is briefly discussed. (auth)

22645 PRODUCTION OF CARRIER-FREE RADIOISOTOPES BY SIMPLE PROCEDURES. Minoru Okada. Tokyo Kogyo Shikensho Hokoku, 58: 58-63(Feb. 1963). (In Japanese)

The radioactive daughter products of radioisotopes formed by slow-neutron irradiation and the radioactive products of (n,p) and (n,α) reactions are easily produced in the carrier-free state, because they respond in a different way to the means used for chemical separation from the matrices or target nuclides. Such isotopes were searched for in the table of isotopes and that of threshold energy. Supposing the use of pile neutrons, it was found that in the half-life range of more than two hours there are about 30 species besides fission products. As examples of production by simple procedures, two experiments were made by the nuclear reactor JRR-1. One of them is production of indium-115m through the stages of: $Cd^{114}(n,\gamma)Cd^{115} \rightarrow In^{115m}$. Another is the production of manganese-56 through (n,p) reaction with iron-56. In both cases, anion exchange resin was used for separation of the final products. (auth)

22646 EMPIRICAL FORMULA FOR INTERNAL CONVERSION COEFFICIENTS. Minoru Okada. Tokyo Kogyo Shikensho Hokoku, 58: 97-9(Feb. 1963). (In Japanese)

The internal conversion coefficient was determined for only a relatively small proportion of all γ rays. About 459 values can be found in the Table of Isotopes (compiled by Strominger, et al., in 1958) including cases where the internal conversion coefficients can be estimated from the related experimental data. The coefficients for these 459 cases were plotted against the γ-energy on a log-log paper, and the center line was found graphically. Equidistant lines which are parallel to the first one were drawn in such a way as 95% of 459 points lie between the latter two lines. From these lines, a formula for internal conversion coefficients was obtained as follows: $e/\gamma < 8.3 \times 10^{-2} E_\gamma^{-3.9}$ (1), and $e/\gamma > 3.7 \times 10^{-6} E_\gamma^{-3.9}$ (2), where e/γ is the internal conversion coefficient and E_γ the γ energy in Mev. The inequality (1) has a probability of 98% and (2) has that of 97%. Examples of the application of these formulas to the estimation of the abundance of unconverted γ photons are described. (auth)

22647 ON THE POLARIZATION OF NUCLEI IN DIRECT NUCLEAR REACTIONS, ALLOWING FOR SPIN-ORBIT INTERACTION. V. F. Kharchenko (Khar'kov State Univ.). Ukr. Fiz. Zh., 7: 11-16(Jan. 1963). (In Ukrainian)

General formulas taking into account spin-orbit interaction were obtained for the angular distribution and polarization of escaping particles and final nuclei in direct nuclear reactions with transfer of the angular momenta (stripping reaction and capture of particles, inelastic scattering of particles), if the incident particles and initial nuclei are polarized. A relation is established between the angular distributions in such reactions with polarized and unpolarized initial nuclei and the polarization of the nuclei. (auth)

22648 INTERNAL CONVERSION OF AN ELECTRIC MULTIPOLE IN THE BORN APPROXIMATION. V. F. Boldyshev (Khar'kov State Univ.). Ukr. Fiz. Zh., 7: 31-5 (Jan. 1963). (In Ukrainian)

The K-shell internal conversion coefficient is considered at the lowest approximation in αZ (α is the fine-structure constant, Z is the charge of the nucleus). The electron wave functions used are approximate solutions of Dirac's equation in spherical coordinates. The final expression of the conversion coefficient is different from the well-known Dankoff-Morrison formula. This difference is explained by incorrect choice of the wave function of the continuous spectrum. (auth)

22649 INVESTIGATION OF THE STRIPPING REACTION ON CHROMIUM ISOTOPES. M. V. Pasechnik and P. G. Ivanitskii (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 1129-35(Apr. 1963). (In Russian)

The angular distributions of protons from the (d,p)-reaction on chromium isotopes Cr^{50}, Cr^{52}, Cr^{53}, and Cr^{54} are studied for 13.6-Mev deuterons. The angular distributions obtained are compared with the simple Butler theory for stripping reactions. The values of l_n for captured neutrons are obtained for the ground and several excited states of the final nuclei. Conclusions are made regarding the possible values of the spins and parities of the states of the final nuclei Cr^{51}, Cr^{53}, Cr^{54}, and Cr^{55}. (auth)

22650 MEASUREMENT OF THE GYROMAGNETIC RATIO OF THE W^{182} NUCLEUS IN THE FIRST EXCITED STATE. V. A. Klyucharev, A. K. Valter, I. I. Zalyubovskii, and V. D. Afanasev (Inst. of Physics and Tech., Khar'kov). Zh. Eksperim. i Teor. Fiz., 44: 1136-40 (Apr. 1963). (In Russian)

The gyromagnetic ratio of the 100-kev level of the W^{182} nucleus is measured according to the perturbation of the $\gamma\gamma$ correlation of the 229–100 kev cascade by an external magnetic field of 35,000 gauss. The coefficients of the unperturbed correlation functions are $A_2 = 0.087 \pm 0.008$ and $A_2 = 0.108 \pm 0.008$ for a solid and liquid source, respectively. The angular shifts of the correlation function are 4°10′ for the solid and 5°53′ for the liquid source which correspond to $g = 0.247 \pm 0.037$ and $g = 0.323 \pm 0.048$. The mean value of the gyromagnetic ratio for the two measurements is $g = 0.285 \pm 0.042$. (auth)

22651 ANGULAR CORRELATION OF γ-QUANTA CASCADE DUE TO THE 440-337 kev TRANSITION IN THE Sm^{150} NUCLEUS. V. Kozhokaru and M. Petrashku (Inst. of Atomic Physics, Bucharest). Zh. Eksperim. i Teor. Fiz., 44: 1141-3(Apr. 1963). (In Russian)

The angular correlation of γ quanta cascade emitted by the excited Sm^{150} nucleus in the 440–337 kev transition is measured for angles at 90, 135, and 180°. An analysis of the experimental data shows that the spin of the second level in Sm^{150} is 4. (auth)

22652 TWO SHORT-PERIOD ISOMERS Ir^{187m} AND Ir^{189m}. V. V. Remaev, V. T. Gritsyna, and Yu. S. Korda (Inst. of Physics and Tech., Khar'kov). Zh. Eksperim. i Teor. Fiz., 44: 1147-50(Apr. 1963). (In Russian)

Results of the millisecond isomer γ activity previously observed by irradiating osmium by fast protons are presented. It is found that proton bombardment of an osmium sample with a natural isotopic composition results in the formation of two isomers, Ir^{187m}($T_{1/2}$ = 29 msec, E_γ = 115 kev) and Ir^{189m} ($T_{1/2}$ = 14 msec, E_{γ_1} = 120 kev, E_{γ_2} = 180 kev, and E_{γ_3} = 300 kev). It is shown that isomer states

of these nuclei are produced in the reactions $Os^{188}(p,2n)Ir^{187m}$ and $Os^{190}(p,2n)Ir^{189m}$. (auth)

22653 PHOTODISINTEGRATION OF Li^7. L. A. Kulchitskii and Yu. M. Volkov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 44: 1153-9(Apr. 1963). (In Russian)

The energy spectra and angular distributions of protons and tritons produced in the photodisintegration of Li^7 are investigated. In the energy spectra of phototritons produced at $E_{\gamma max}$ = 30 Mev, groups are observed that correspond to excitation energies of 14.1, 16.2, 18.0, 19.6, 21.5, 23.5, and 25.3 Mev. In most of the energy ranges the triton angular distributions have the form $\sim\sin^2\vartheta$. Pronounced peaks were also found in the Li^7 photoproton spectra. However, for $E_{\gamma max}$ = 25 and 30 Mev the majority of the observed protons correspond to transitions to the excited states of the He^6 nucleus. (auth)

22654 NEUTRON POLARIZATION IN THE D(d,n)He^3 REACTION. I. S. Trostin and V. A. Smotryaev (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1160-1 (Apr. 1963). (In Russian)

Values of the polarization of neutrons emitted at various angles (θ_n) from a deuterium target for deuteron energies E_d = 12.0 ± 0.6 and 9.0 ± 0.7 Mev are obtained with the aid of a helium analyzer and by employing the Seagrave phase shifts for nα scattering. (auth)

22655 PANOFSKY RATIO FOR He^3 AND THE MEAN SQUARE RADIUS FOR THE $He^3 \rightarrow H^3$ TRANSITION. O. A. Zaimidoroga, M. M. Kulyukin, R. M. Sulyaev, I. V. Falomkin, A. I. Filippov, V. M. Tsupko-Sitnikov, and Yu. A. Shcherbakov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1180-3 (Apr. 1963). (In Russian)

Capture of mesons (π^-) stopped in He^3 was observed for the first time. The $\pi^- + He^3 \rightarrow H^3 + \pi^0$ and $\pi^- + He^3 \rightarrow H^3 + \gamma$ reactions were singled out. The Panofsky ratio (ratio of probabilities for above mentioned reactions) was determined for He^3. This value is used for estimating the mean square radius for the $He^3 \rightarrow H^3$ transition. (auth)

22656 ELASTIC SCATTERING OF 4.2-Mev PROTONS ON NICKEL ISOTOPES. V. Ya. Golovnya, A. P. Klyucharev, B. A. Shilyaev, and N. A. Shlyakhov. Zh. Eksperim. i Teor. Fiz., 44: 1184-6(Apr. 1963). (In Russian)

The angular distributions of 4.2 Mev protons elastically scattered on $Ni^{58,60,62,64}$ isotopes are derived by a comparison method. The shapes of the curves for Ni^{58} and Ni^{60} that have sharp maxima in the angular distribution are found to differ from those for Ni^{62} and Ni^{64}. A possible explanation of the difference is discussed. (auth)

22657 NEUTRON SPECTROSCOPY INVESTIGATIONS OF NUCLEAR LEVELS. I. NEUTRON CROSS SECTIONS OF MOLYBDENUM ISOTOPES IN THE 7-15000 ev ENERGY RANGE. M. I. Pevzner, Yu. V. Adamchuk, L. S. Danelyan, B. V. Efimov, S. S. Moskalev, and G. V. Muradyan. Zh. Eksperim. i Teor. Fiz., 44: 1187-94 (Apr. 1963). (In Russian)

Measurements of the total neutron cross sections and radiative capture cross sections of molybdenum are presented. They were obtained by means of a linear electron accelerator and a time-of-flight neutron spectrometer. The highest resolution in the measurements of the total cross sections was 0.006 μ sec/m. The parameters of a number of resonance levels are determined by taking into account interference between the potential and resonance scatterings. The strength function $\overline{\Gamma_n^0}/D$ for each of the isotopes is also determined. A number of weak levels ascribed to the p wave were detected. The problem of identical positions of levels belonging to different isotopes is discussed. (auth)

22658 NEUTRON TRANSFER BY THE Be^9 NUCLEUS. S. N. Shumilov (Inst. of Physics and Tech., Khar'kov). Zh. Eksperim. i Teor. Fiz., 44: 1199-1203(Apr. 1963). (In Russian)

The mechanism of Be^8 production due to the interaction of 85-Mev Be^9 ions with silver and bromine nuclei in the photographic emulsion is investigated. The angular distribution of the Be^8 nuclei produced in the ground state has two pronounced peaks in the small angle range; the angular distribution of Be^8 in the excited states has only a single peak located at smaller angles. The Be^8 yield as a function of the Be^9 ion energy is investigated. The closest approach of the interacting nuclei involved in the formation of the Be^8 nucleus in the ground state is estimated and the value $r_0 = 1.95 \times 10^{-13}$ cm is deduced. It is shown that the main mechanism of Be^8 formation is neutron transfer. (auth)

22659 FORMATION OF THE ISOMERIC PAIRS TECHNETIUM-96, TECHNETIUM-95, AND TECHNETIUM-94 BY (α,xn) REACTIONS ON NIOBIUM-93. John Michael Matuszek, Jr. Thesis, Worcester, Mass., Clark Univ., 1962. 183p.

The individual formation cross sections and recoil ranges for the isomeric pairs Tc^{96}, Tc^{95}, and Tc^{94} as produced in the $Nb^{93}(\alpha,xn)$ reactions were measured as a function of α-particle energy. The resultant excitation functions, isomeric ratio curves, and recoil range curves show many fluctuations with energy. Possible explanations are offered. Invoking competition between neutron emission and γ-ray emission in the decay steps appears to account for all of the abnormal effects noted in the experimental curves for all three reactions. The isomeric ratio predicted by Matsuo's surface-interaction model gives a good fit to the (α,n) direct interaction, though it must be modified slightly for the (α,2n) case. In the compound-nucleus region the energy dependence of the isomeric ratios was compared with that calculated using level-density expressions from a statistical model of an excited nucleus. These calculations, together with results from other work, indicate that the density of spin states of an excited nucleus can be related to the rotational shape of the nucleus, particularly for nuclei which are one nucleon removed from a magic number. In the course of the research, a new Tc isomer following a 293-min half-life was found. From its mass and decay characteristics, the new isomer was assigned to the ground state of Tc^{94}. A decay scheme has been proposed. (M.P.G.)

22660 COMPUTATIONS OF THE SCATTERING OF RELATIVISTIC ELECTRONS BY SCREENED ATOMIC NUCLEI. Shin-R Lin. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 201p.

The elastic scattering of the relativistic electrons by exponentially screened nuclei is calculated numerically. The electron energies are chosen to be 121 kev for gold and v/c = .4 and .5 for mercury. The main quantities of interest are the asymmetry factor $S(\theta)$ and the differential cross section. These are calculated from the phase shifts. The calculations are made on an IBM 704 Computer. The theory of the scattering process based on the density matrix formalism is presented. The spin operator $\vec{O}$ and the average polarization vector $\vec{P}$ are de-

fined. A 2 × 2 matrix M which connects the upper components of the incident wave to the upper components of the scattered wave is introduced. The methods for computing the phase shifts $\delta_{\frac{1}{2}}$ and $\delta_{-\frac{1}{2}-1}$ are developed. The results of the computations are reported. The errors in the phase shifts, S and $d\sigma/d\Omega$, are discussed. The effect of screening on S is less than 3% at large angles (90° to 135°) where the measurements are usually performed for gold at T = 121 kev and for mercury at v/c = .4. Since in these cases the error in S is of the same order as the effect of screening, the values of S for the pure Coulomb fields may be used in experiments. The effect of screening is prominent in one case, v/c = .5 for mercury. These S(120°) and S(135°) deviate from the Coulomb values as much as 15%. If the estimate of the errors is correct, these deviations should easily be observed experimentally. (M.P.G.)

22661 FRAGMENT ANGULAR DISTRIBUTIONS FROM NEUTRON AND ALPHA-PARTICLE-INDUCED FISSION. Leroy Norman Blumberg. Thesis, New York, Columbia Univ., 1962. 88p.

Angular distributions of fragment activities from neutron-induced fission of U^{233}, U^{234}, U^{235}, U^{236}, U^{238}, Np^{237}, Th^{232} and Pu^{239} have been measured in the energy range $8 \lesssim E_n \lesssim 15$-Mev and, for U^{235}, at additional energies $E_n \lesssim 5$-Mev by a catcher foil technique. Angular distribution measurements are also reported for α-particle-induced fission of Th^{232} and U^{236} in the energy range $17 \lesssim E_\alpha \lesssim 28.7$-Mev. Results of an analysis of the anisotropy at $E_n \approx 11.8$-Mev, based on use of the semiclassical anisotropy expression of Halpern and Strutinskii, are discussed. The present anisotropy data for α-particle-induced fission of Th^{232} are compared to corresponding data for neutron-induced U^{235} fission, where the same compound nucleus is formed in the same excitation energy range. Comparisons of anisotropies n + Pu^{239} and $\alpha + U^{236}$, where again the same compound nuclei are formed, are also made. The data for U^{235} (n,f) at neutron energies $E_n \lesssim 5$-Mev confirms previous results of Simmons and Henkel and further supports the suggestion that target spin enhances fission anisotropy. (M.P.G.)

22662 SCATTERING OF PROTONS OF C^{12} IN THE ENERGY RANGE OF 5-6 Mev. Nikola Milana Nikolic. Thesis, New York, Columbia Univ., 1962. 119p.

Three resonances were observed in the bombarding energy range 5 to 6 Mev. At 5.38 Mev bombarding energy, which corresponds to 6.91 Mev excitation energy in N^{13}, the resonance has $j^\pi = 3/2^+$ ($D_{3/2}$). Its total width in the laboratory is 125 ± 5 kev. At 5.68 Mev bombarding energy, which corresponds to 7.19 Mev excitation energy in N^{13}, the resonance has very probably, but not certainly, $j^\pi = 7/2^+$ (G7/2). Its total width in the laboratory system is 10 ± .5 kev. At 5.90 Mev bombarding energy, which corresponds to 7.40 excitation energy in N^{13}, the resonance has $j^\pi = 5/2^-$ (F5/2). Its total width in the laboratory system is 75 ± 5 kev. The intermediate-coupling shell-model calculations for an A = 13 nucleus require a $7/2^+$ state of excitation energy of ~7.5 Mev and a $5/2^-$ state at excitation energy of 4 to 5 Mev. We have identified a state at 7.19 Mev that has all the properties consistent with a spin-parity assignment of $7/2^+$. Therefore the existence of the $7/2^+$ state as calculated theoretically should be considered verified experimentally with a high degree of probability. In contrast, the $5/2^-$ assignment for the 7.40 Mev state is certain. However, its energy is quite high when compared with the energy that is predicted for it. This would indicate that the choice of L/K = 6.8 that was made has to be changed to get an agreement between experiment and calculation. Finally, it has been found that the p′-γ angular correlations of energies around the 5.90 Mev (bombarding energy) show asymmetry around 90° cm. Two possible causes were investigated: interference between states, and direct interaction. Analysis showed that the direct interaction is almost certainly the cause of observed asymmetries. (M.P.G.)

22663 THE IMAGINARY PART OF THE OPTICAL POTENTIAL. Ahmed F. Mohammed Abdel-Bary. Thesis, Columbus, Ohio State Univ., 1962. 88p.

An explicit expression for the nuclear potential in terms of the radial wavefunctions and of the t-matrix for the interaction of two nucleons is obtained. The imaginary part of the nucleon-nucleus optical potential is calculated as a function of the distance from the center of the nucleus for 6.5-Mev neutrons incident upon O^{16} and Ca^{40}. The problem is treated throughout in terms of the nuclear wavefunctions obtained from a harmonic-oscillator potential, the free parameter of the potential being chosen to make the root-mean-square radius of the nuclear-density distribution agree with that obtained by electron-scattering experiments. The Pauli principle is effected by projecting, out of the possible final states for a scattered particle, those states occupied by the particles of which the nucleus is composed. The procedure is general and can be applied for low energy neutrons incident upon any nucleus. The curves for the imaginary part of the optical potential and for the nuclear density are plotted for comparison in cases of O^{16} and Ca^{40}. Calculations indicate that the depth of the imaginary part of the optical potential is not given by a constant times the nuclear density, but increases as we approach the edge of the nucleus. (M.P.G.)

Particle Accelerators

22664 (ML-915) EXPERIMENTAL INVESTIGATION OF TRANSMISSION-LINE REPRESENTATIONS OF MICROWAVE PERIODIC CIRCUITS. Mary Irene Carswell (Stanford Univ., Calif. Microwave Lab.). Apr. 1962. Contract AF30(602)-2575. 118p. (AD-282945; RADC-TDR-62-241)

Research is presented on transmission line models of a type of periodically-loaded waveguide that is important to the design of high power traveling wave tubes and linear accelerators. A simple and well-known model, referred to as the single-line model, is described in terms of a single transmission line periodically loaded with shunt susceptances; the model has the limitation that direct coupling between neighboring irises is not accounted for when the simple one-port element is used to represent the network properties of a thin transverse iris. The model is then improved in such a way that this limitation is removed to a first order of approximation; the iris is assumed to behave as a shunt two-port network coupling smooth transmission lines having the properties of appropriate normal waveguide modes. This latter formulation of the two-port representation of a waveguide iris is new. It is found experimentally that the new model of the structure, referred to as the two-line model, covers a class of circuits used in practical applications. (auth)

22665 (ORNL-TM-550) SOURCE-STRENGTH AND LONG-COUNTER-RESPONSE CALIBRATIONS AT THE BSF 300-kev ACCELERATOR. E. G. Silver (Oak Ridge National Lab., Tenn.). Apr. 8, 1963. Contract [W-7405-eng-26]. 11p.

By means of an Am-Be neutron source calibrated by the National Bureau of Standards the absolute neutron production of the 300-kev Cockcroft-Walton accelerator and of another Am-Be source was measured. The response of a modified Hanson-McKibben long counter as a function of distance from the source and angular orientation was also measured. (auth)

22666 (TID-18561) LINEAR ACCELERATOR PROJECT. Progress Report, January–March 1963. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 53p.

The asymptotic neutron spectrum was measured for the first of the three proposed multiplying medium spectrum sources. Both the reentrant hole spectrum (scalar flux) and the surface spectrum were measured. All large corrections were made to the data, and the scalar spectrum was calculated for a comparison between the two. As part of a study of the effects of coherent neutron scattering in crystalline moderators, time dependent neutron spectra for Be with a buckling of $0.073/cm^2$ and for several mean lifetimes after the primary burst were obtained. The transport cross section for Be and a maxwellian spectrum at 30°C were also obtained. The data indicate trapping at Bragg energies of 0.022 and 0.007 ev. Evidence that an asymptotic spectrum does not result for the delay time considered is noted. Results of a previous series of die-away measurements for H_2O are presented. The neutron capture spectrometer used in cross section measurements on Hf and W was improved; analysis of data continued; and a program was written to aid in area analysis of resonances that are close to or overlapped by a neighboring resonance. The capture-to-fission ratio (alpha) of U^{235} over the energy range 1 to 1000 ev was measured. Preliminary experiments revealed that reasonable counting rates in a good resolution low-energy neutron inelastic scattering experiment can be obtained and that previous estimates of achievable resolution are reasonably accurate. Design of a large-aperture 30,000 rpm chopper was almost completed. Validity of the discrete energy representation in the neutron thermalization problem was examined along with the sensitivity of the usual pulsed experiments in moderating materials to the energy exchange kernels used to describe the experiments. Research on time dependent neutron spectra, time dependent spectra in fissionable assemblies, and time dependent transport theory was carried out. The MESSY-3 program was generalized to find both the eigenvalues of the thermal space energy problem and the pulsed decay constants in finite moderators, in PL approximations up to P-45. Generation of P_0 energy exchange kernels for hydrogeneous moderators by using an analog of the Radkowsky effective mass scheme for the P-1 kernel was investigated. Calculations gave fair cross sections and spectra. Comparison of experimental and theoretical determinations of the diffusion cooling coefficient of H_2O and the coefficient's energy dependence were investigated. (D.C.W.)

22667 (TID-18578) THE UNIVERSITY OF MICHIGAN 83-INCH CYCLOTRON. Progress Report No. 11, Jan. 1, 1963–March 31, 1963. W. C. Parkinson and R. S. Tickle (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). Apr. 1963. Contract AT(11-1)-921. 5p. (ORA/03763-11P)

The two gradient coil assemblies were aligned and connected, and magnetic field measurements were made to determine the effect of each coil for a given current. Two reactors failed during acceptance tests of the r-f power supply; after repairs the supply operated satisfactorily. The cyclotron was reassembled, and r-f tests were conducted under continuous power. The system operated satisfactorily, although the dee voltage regulator was inoperative. The frequency can be continuously adjusted over its design range under load. The three analyzer magnet power supplies were tested and installed, and one magnet was assembled for testing. During tests in which protons were accelerated to about 8 Mev, it was established that the gradient coils are necessary to prevent a blow-up of the beam at a radius of about 33 inches. (D.C.W.)

22668 (TID-18589) THEORY AND PERFORMANCE OF THE RADIO FREQUENCY ION SOURCE. PART I. THEORY AND MECHANISM OF THE LOW PRESSURE PLASMA USED IN RADIO FREQUENCY ION SOURCES. M. E. Abdelaziz (Argonne National Lab., Ill.). Apr. 14, 1960. PART II. EXTRACTION OF ION BEAMS FROM THE R. F. PLASMA. M. E. Abdelaziz (Argonne National Lab., Ill.). Sept. 1, 1960. Contract [W-31-109-eng-38]. 47p.

I. Expressions are derived for the electron concentrations in r-f ion sources when secondary emission from the walls is taken into account. Evaluation of the concentration at any radius is also treated. Dissociation of the hydrogen molecule into two atoms and ionization processes of the hydrogen molecule are examined. An analysis of the extraction of ion beams from an r-f source is presented. II. Design charts for the exit canal of the source are prepared to give characteristics of the extracted ion beam corresponding to different canal sizes and running conditions of the source. The focusing properties of the beam between the plasma boundary and the canal are analyzed considering the theory of conical flow of proton beams between spherical surfaces. Such analysis gives the dimensions of the beam-forming cathode shield. The theory of radial potential distribution in an intense beam is applied to find its effect on design calculations from the first order theory and how the resulting blow up forces contribute to the losses in beam current inside the metal canal. 30 references. (auth)

22669 (UCRL-10561) BEVATRON OPERATION AND DEVELOPMENT. XXXIII. [Period Covered] February–April 1962. Kenneth C. Crebbin, William A. Wenzel, Fred H. G. Lothrop, and Rudin M. Johnson (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 12, 1963. Contract W-7405-eng-48. 16p.

Experimental work consisted of one new run started and completed this quarter, and the completion of one of the three continuing runs. Of the scheduled operating time, the beam was on for 69.4% of the time, 2.3% of the time was used for experimental setup, and equipment outage took 29.3% of the time. There were two scheduled and two impromptu shutdowns. During one of the scheduled shutdowns the external-beam extraction magnets were installed in the east and south tangent tanks. The other scheduled shutdown was to readjust the Bevatron magnet elevation to correct for foundation subsidence. Internal magnets were also installed. In the new linac development program the ion source was run at 480 kv with a beam current of 100 ma. The linac tank was partially deplated to provide a clean copper surface, and welds and holes were plated with copper. The r-f losses were thereby reduced 20%. (auth)

22670 (UCRL-10758) OPERATION OF THE BERKELEY 88-INCH CYCLOTRON. Hermann A. Grunder and Frank B. Selph (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 16, 1963. Contract W-7405-eng-48. 28p.

The operation of the Berkeley 88-inch spiral ridge cyclotron in the past year is reviewed. Internal beam qualities and intensities, and the stability, reproducibility, and lifetime of various machine components are discussed. Examples of the use of phase diagrams obtained from I vs R curves to tune the magnetic field shape are presented. (auth)

22671 (UCRL-10759) OPERATING EXPERIENCE WITH THE BERKELEY 88-INCH-CYCLOTRON ELECTROSTATIC DEFLECTOR. Hermann A. Grunder, Frank B. Selph, and Hugo Atterling (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 17, 1963. Contract W-7405-eng-48. 27p.

Measured extraction efficiencies and beam currents are presented. The use of first-harmonic coils and their influence on extraction efficiency and beam quality are discussed. Reproducibility of the virtual source position, effects of changes in deflector position and voltage, and emittance measurements for various external beam currents are included. (auth)

22672 THE LINEAR ACCELERATOR INSTALLATION AT RISØ. N. W. Holm (Research Establishment, Riso, Denmark). Atomwirtschaft, 8: 99-100(Feb. 1963). (In German)

The reasons for the decision to erect a 10-Mev electron linear accelerator installation at Risö are given. The characteristics of the accelerator and its housing are described. (J.S.R.)

22673 EFFECT OF SPACE CHARGE ON THE BEAM STABILITY IN SYNCHROTRONS AND STORAGE RINGS. Francis Fer and Claude Delcroix (Faculté des Sciences, Orsay, France). Compt. Rend., 256: 2305-7(Mar. 11, 1963). (In French)

There is a density of beam particles in a synchrotron beyond which the beam becomes unstable. In storage rings with electron-positron or electron-electron collisions, there is also a density beyond which the collisions cease with the two beams turning around each other. It is shown that the usual density limits assumed are not definitive and that there are a number of areas of increasing densities where radial and vertical stabilities are found. (J.S.R.)

22674 CAN THE ENERGY IMPRECISION ON A TARGET INSIDE A CIRCULAR ACCELERATOR BE REDUCED? João Andrade e Silva and Georges Lochak (Faculté des Sciences, Orsay, France and Institut Henri Poincaré, Paris). Compt. Rend., 256: 2308-10(Mar. 11, 1963). (In French)

It is shown that the energy of particles received by a target inside a circular accelerator (with weak convergence) is better known and weaker, on an average, when the measurement is made toward the center of the target. This property allows a considerable reduction in the energy imprecision on one part of the target. (tr-auth)

22675 COMPLEMENTARY REMARKS ON THE EFFECT OF SPACE CHARGE ON THE STABILITY OF BEAMS IN SYNCHROTRONS AND STORAGE RINGS. Francis Fer and Claude Delcroix (Faculté des Sciences, Orsay, France). Compt. Rend., 256: 2544-6(Mar. 18, 1963). (In French)

The existence of multiple density regions assuring the stability of a synchrotron beam was shown to extend to the case of storage rings where the space charge also interferes in the collisions. (J.S.R.)

22676 ON THE VARIATION OF BEAM BOUNDARIES IN LINEAR BEAM TRANSPORT ELEMENTS AND THE COMPUTATION OF SPACE-CHARGE EFFECTS. P. T. Kirstein (Joint Inst. for Nuclear Research, Dubna, USSR). J. Electron. Control (1), 14: 241-72(Mar. 1963).

First the properties of monochromatic relativistic beams in linear beam transport elements are considered, neglecting space-charge effects. Under the assumption that the initial beam occupies an elliptical region in phase space, equations are set up for the variation of the parameters of the ellipse along the beam transport system. The equations are solved for uniform long lenses, point lenses, and drift spaces. It is shown how it is possible to obtain an ellipse of minimum area in phase space, which completely circumscribes the region defined by two pairs of apertures. Formulas are developed to determine where such apertures should be placed, in order to define an ellipse in the optimum way. Equations are set up for the perturbation of elliptic boundaries in phase space by non-linear fields. Although Liouville's theorem must be satisfied, so that phase space area is conserved, the region occupied by the beam may have an awkward shape which cannot be used in practice. Formulas are derived for estimating the rate of growth of usable phase-space area due to non-linear fields. These formulas are applied to the calculation of the perturbation of the boundaries in phase space due to space charge in sheet and axially symmetric beams. The increase of effective area in phase space due to space charge is also estimated. Finally, the results are applied to the estimation of the area in phase space which will be occupied by an axially symmetric beam coming out of a linear accelerator such as a Van de Graaff generator. The agreement with the experimental results is shown to be good. (auth)

22677 A LIQUID HYDROGEN–DEUTERIUM TARGET FOR USE WITH THE BIRMINGHAM 1 Gev PROTON SYNCHROTRON. C. Barrow, G. H. Guest, and L. Riddiford (Univ. of Birmingham, Eng.). J. Sci. Instr., 40: 260-1(May 1963).

An assembly which will contain targets up to 16 in. long is described. A means of emptying and refilling the target rapidly during an experiment is explained. (auth)

22678 METHOD OF ADJUSTMENT OF TWO QUADRUPOLE LENSES. B. Anders, S. Hiekmann, H. Odrich, and H. Trautmann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 63-5(Feb. 1963). (In German)

On the Rossendorf cyclotron two quadrupole lens were used for focusing the out-going particle beams. The method by which the lens are adjusted is described. The distance between focus and lens system amounts to more than 600 cm. (tr-auth)

22679 PULSE-SHORTENING IN ELECTRON LINEAR ACCELERATORS AND E_{11} TYPE MODES. M. Bell, P. Bramham, B. W. Montague (European Organization for Nuclear Research, Geneva). Nature, 198: 277-8(Apr. 20, 1963).

Detailed theoretical and experimental investigations were made of E_{11} type fields in circular, iris-loaded waveguides, specifically to utilize the deflecting forces for the spatial separation of high-energy particles of different rest masses. Possible methods of suppressing pulse-shortening phenomena in electron linear accelerators and E_{11} type modes are discussed. (C.H.)

22680 STRUCTURE OF NUCLEI PROBED BY NEW VAN DE GRAAFF. D. A. Bromley (Yale Univ., New Haven). Nucleonics, 21: No. 5, 48-51; 54-5(May 1963).

A new tandem Van de Graaff accelerator that will produce 10-25 μa of monoenergetic protons at 20 Mev is described. A number of areas in contemporary research where major

progress may be anticipated through utilization of the characteristics of this new accelerator are briefly reviewed. (C.E.S.)

22681 DEVELOPMENT OF A TANDEM VAN DE GRAAFF ACCELERATOR FOR PROTONS OF 2 Mev. Juergen Kalus (Technische Hochschule, Munich). Nukleonik, 5: 8-15(Jan. 1963). (In German)

The construction and performance of a tandem Van de Graaff accelerator working under atmospheric pressure for protons with energies up to 2 Mev are described. The proton current is, at present, approximately 0.35 μ amp. The particle current at the collector is composed principally of protons with energy E and neutral hydrogen with energy E/2. The ion optical properties of the accelerator tube, as well as the mode of operation and yield of the ion charge in a gas, were calculated and experimentally tested. (tr-auth)

22682 ACCELERATING FIELD FOCUSING. G. M. Anisimov and V. A. Teplyakov. Pribory i Tekhn. Eksperim., No. 1, 21-2(Jan.-Feb. 1963). (In Russian)

Stable longitudinal and transverse ion motion was achieved in a linear ion accelerator without field focusing by creating an axially asymmetric field. (tr-auth)

22683 HIGH-FREQUENCY ION SOURCE FOR ELECTROSTATIC GENERATOR. V. A. Romanov and A. N. Serbinov. Pribory i Tekhn. Eksperim., No. 1, 27-30 (Jan.-Feb. 1963). (In Russian)

A high-frequency ion source for an electrostatic generator, with 1.6 cm^3/hr hydrogen consumption, and 90 and 230 μa current at 40 and 100 v respectively, is described. The source can be operated for 500 hours. (tr-auth)

22684 ENERGY AND PHASE PERFORMANCE OF A LINEAR ELECTRON ACCELERATOR WITH WAVE PROPAGATION PHASE VELOCITY EQUAL TO THE VELOCITY OF LIGHT. I. F. Kharchenko, I. A. Grishaev, and A. M. Nekrashevich (Khar'kov State Univ.). Ukr. Fiz. Zh., 7: 1051-61(Jan. 1963). (In Ukrainian)

A curve-analysis method of calculation of the dynamical longitudinal motion of electrons and energy performance of a 7 Mev linear electron accelerator with wave propagation phase velocity of light are described in the presented paper. The prebunching of electrons to be accelerated was used to improve the performance of the device. The calculation has proved that performance of a linear accelerator of this kind would not be worse than that with variable accelerating wave phase velocity. Taking this calculation as a principle, a linear electron accelerator was built whose output performance was in good agreement with the calculated one. (auth)

22685 ACCELERATION OF CHARGED PARTICLES BY OSCILLATING MAGNETIC FIELD. V. A. Ankudinov, V. M. Kel'man, and L. S. Sysoeva (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 19-27(Jan. 1963). (In Russian)

Acceleration of charged particles by oscillating magnetic fields was investigated, and magnetic field intensity variables were resolved using previously integrated nonrelativistic equations and formulas developed for the spatial and energy distribution of particles moving in homogeneous periodically oscillating magnetic fields. The kinetic energy of a charged particle was determined after several magnetic field cycles in which the time interval of the field intensity, τ, increased linearly with time from zero to $H_1 = H_0\tau$. The particle energies after the first and second cycles are constructed as functions of field variations, and diagrams are given of particle trajectories. (R.V.J.)

22686 ON THE SELECTION OF ELECTRON ACCELERATION FIELD FREQUENCY FOR HIGH-ENERGY ACCELERATORS. A. N. Didenko and E. S. Kovalenko. Zh. Tekhn. Fiz., 33: 28-33(Jan. 1963). (In Russian)

The variable shunt resistances of resonator and waveguide acceleration systems were studied as functions of frequency. Considering quantum fluctuations the optimum frequencies are higher for waveguides than for resonators. Calculations are given for high energy electron synchrotrons. (tr-auth)

22687 ACCELERATOR PROGRAM (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-959)

This is a collection of "Q" numbered drawings that has been used in the ORNL accelerator program including the corona single plate and atmosphere chambers; palladium tube regulator; gas supply bottle; equipment for the Leece-Neville generator; sample adjusting unit; oven extension; and helium system (see also CAPE-960 for high vacuum valves). (F.L.S.)

22688 PREMIER COLLOQUE INTERNATIONAL SUR LA PROTECTION AUPRÈS DES GRANDS ACCÉLÉRATEURS, ORGANISÉ A ORSAY ET SACLAY LES 18, 19 ET 20 JANVIER 1962. (First International Conference on Shielding Around High Energy Accelerators, Orsay and Saclay, January 18, 19, and 20, 1962). P. Bonet-Maury, F. Duhamel, and Francis Perrin. Paris, Presses Universitaires de France, 1962. 163p.

Twenty-one articles on effects of exposure of animals to accelerator radiation, design of accelerator shielding, dosimetry and monitoring around accelerators, and associated problems in health physics are included. Abstracts were prepared for nineteen articles; the other two were previously abstracted in NSA. (D.C.W.)

22689 RADIATION STANDARDS AVAILABLE FOR THE PROTECTION OF HIGH ENERGY ACCELERATORS. H. Jammet (CEN, Fontenay-aux-Roses, France). p.15-20 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

Shielding standards for high energy accelerators require the use of Relative Biological Effectiveness (RBE) to convert values in rads given by instruments to values in rems. This factor is related to Linear Energy Transfer (LET). The RBE values presently used, particularly those based on the International Commission of Radiological Protection are not an adequate approximation of the reality. Some recommendations are given here to approach the true values. In addition to LET and LET–RBE relations complexity, physical factors, particularly delivered dose, dose distribution in tissues, space and time, and biological factors such as the selection of a biological test and the extrapolation from one biological factor to another must be taken into account. It is concluded that RBE must be divided into two parts: the experimental RBE takes into account all the protection factors, the protection RBE uses the criticality concept and is based on the most sensible radiation effect. (auth)

22690 PRELIMINARY RESEARCHES ON THE LETHAL DOSE FOR MICE, OF IRRADIATION BY THE FRASCATI SYNCHROTON. T. Alescio, C. Biagini, E. Borghese, and M. Ladu (CNEN, Frascati, Italy). p.21-5 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

Lethal effects on mice of the 1000 Mev beam of the Frascati synchrotron were studied. The mice were irradiated in file, in groups of five; their behavior is shown to vary with

their location. The beam energy was measured in sweeps of the collecting quantameter: The exposure dose, in r, was estimated by means of ionization chambers holding the mice location. Preliminary results are given in tabular and graphical form. It is shown that LD_{50} is approximately 1000 r. (auth)

22691 R.B.E. DETERMINATION OF THE HIGH ENERGY RADIATION. P. Bonet-Maury, A. Deysine, M. Frilley, and C. Stephan (Université de Paris, Orsay, France). p.27-32 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

A group of mice was irradiated with 157 Mev protons at the synchrocyclotron of the Orsay Institute of Radium. The mortality dose effects curves were used as a basis for the determination of the lethal dose $L.D_{50}/8$ days. Mice of the same breeding, were exposed to reference radiations of a 250 kv x-ray tube. A ratio of 0.77 ± 0.01 between the two LD_{50}'s was obtained for RBE relating to the lethal effects of 157 Mev protons on whole body irradiated mouse. The lethal effect of the same radiation on Salmonella Typhi bacteria in serum medium corresponds to similar values. The experimental data are in good agreement with the predicted values deduced from the mean LET of protons used. (auth)

22692 MEDICAL ASPECTS OF AN ACCIDENTAL EXPOSURE TO VAN DE GRAAFF GENERATOR. S. P. Bliss (Sandia Corp., Albuquerque, N. Mex.). p.37-9 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

A description is given of an accidental exposure to β radiations that occurred to a worker setting up an experiment in front of the drift tube of a 2-Mev Van de Graaff accelerator in self charge. In duplicating the conditions of the accident, it was possible to define the intensity and types of radiation exposures to various parts of the body. A detailed history of the clinical observations made on the patient during the 409 days following the exposure is given. The treatment applied is described showing that some cases of radiation exposures can be best handled on an outpatient basis. Some complications including the loss of two fingers were nevertheless recently observed; others are anticipated. (auth)

22693 PHENOMENOLOGICAL AND THEORETICAL METHODS OF SHIELDING DESIGN. S. J. Lindenbaum (Brookhaven National Lab., Upton, N. Y.). p.43-55 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

Several general phenomenological and theoretical methods for high energy accelerator shielding design are presented and discussed. These include methods for estimating attenuation of the nucleonic and other components, and the accompanying buildup of nucleonic secondaries, by the use of appropriate input nucleonic cascade data together with phenomenological calculations utilizing removal mean free paths, buildup factors, and geometrical considerations. Other methods of estimating attenuation, including the Monte Carlo method, are generally described. Methods for estimating source distributions of radiation, the general analysis of the neutron skyshine problem, and also the muon problem that occurs at the very high energies are presented. Application of these methods to specific accelerator shields is illustrated. (auth)

22694 THEORETICAL STUDIES ON THE TRANSPORT OF HIGH ENERGY RADIATION THROUGH SHIELDING MATERIALS. Claython D. Zerby (Oak Ridge National Lab., Tenn.). p.57-63 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

Several calculations are being performed at the Oak Ridge National Laboratory to study the transport of high-energy nucleons, pions, and muons through the shielding materials used on high-energy accelerators. In one calculation the Boltzmann transport equation with the straight-ahead approximation is solved numerically, and the radiation intensities and tissue dose rates are calculated as a function of depth. Some studies with source energies up to 45 Bev were carried out with this calculation. The physical information about secondary radiation needed in this calculation was derived from the emulsion data of Camerini, Lock, and Perkins. A Monte Carlo calculation of the transport of high-energy radiation is also in preparation that will consider source energies up to 30 Mev. The cross-section data and details of the production of secondary radiation needed in this calculation are provided by separate intranuclear cascade and nuclear evaporation calculations. Studies of electron initiated electron-photon cascades were also performed for machines that accelerate electrons up to 45 Bev. (auth)

22695 METHOD OF CALCULATION OF THE SHIELDING ENCLOSURE FOR THE BERKELEY BEVATRON. Burton J. Moyer (Univ. of California, Berkeley). p.65-70 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

Presented here are the method and results of the calculation of specifications for the complete shielding enclosure adequate to accommodate a beam intensity of 10^{13} protons per pulse (10 pulses/min) at 6.2 Bev kinetic energy. The production characteristics of the high-energy neutrons are considered; their attenuation is discussed; and an estimation is given for the radiation emerging from the outside surface of the shield. The propagation of radiation to off-site areas is discussed. (auth)

22696 DESIGN OF PROTECTION SHIELDS FOR HIGH ENERGY ACCELERATORS. M. Ladu and M. Petilli (CNEN, Frascati, Italy). p.71-3 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

The methods developed at Frascati for computing high energy accelerator shielding are described. The calculation is similar for proton and electron accelerators, aside from different secondary radiation interactions. It includes the determination of secondary radiation interactions (electromagnetic cascades, photoneutrons, photomesons) and of the thickness of various materials shields required to reduce emerging radiation to permissible levels. Thicknesses to obtain the MPC at ten meters from the shield are given. For electron accelerators, the thickness required is proportional to $E^{0.18}$ from 1 to 10 Bev and to $E^{0.11}$ from 10 to 100 Bev. For proton accelerators, it is proportional to $E^{0.085}$ from 1 to 100 Bev. (auth)

22697 THE HEALTH PHYSICIST AND HIS RESPONSIBILITIES IN THE DESIGN OF HIGH ENERGY ACCELERATORS. P. Candès (CEN, Saclay, France). p.75-7 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

Problems in health physics and shielding associated with high-energy accelerator protection are briefly discussed.

Problems connected with the target area, secondary radiations, and the accelerator ring are examined along with means for detecting radiation. The material is slanted to show the necessity for co-operation of the health physicist in design work. (D.C.W.)

22698 SKYSHINE MEASUREMENTS AROUND THE RUTHERFORD LABORATORY PROTON LINEAR ACCELERATOR. R. H. Thomas (National Inst. for Research in Nuclear Science, Harwell, Berks, Eng.). p.83-8 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

Measurements of neutron fluxes at distances up to 1,000 ft from the proton linear accelerator at the Rutherford Laboratory were made using a long counter and paraffin wax moderated indium foils. The simplest interpretation of the results gives an inverse square reduction of flux with distance. "Skyshine" theory predicts fluxes three times higher than those measured at large distances. (auth)

22699 ATTEMPT TO DEVELOP PERSONNEL DOSIMETER FOR HIGH ENERGY IONIZING PARTICLES. G. Portal (CEN, Fontenay-aux-Roses, France). p.89-93 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

A dosimeter for monitoring personnel exposed to high energy ionizing particles around large accelerators was developed. Nuclear emulsions of the Ilford K5 type, used so far near the proton synchrotron Saturne, can only measure ionizing particles flux. With this dosimeter, it is possible to evaluate incident particle ionizing power and flux. It consists of a stack of different sensitivities of nuclear emulsions. The dosimeter can be routinely processed without major difficulties. It has been used for some measurements around Saturne proton synchrotron. (auth)

22700 THE EFFECT OF SHIELDING ON RADIATION PRODUCED BY THE 730 Mev SYNCHROCYCLOTRON AND THE 6.3 Gev PROTON SYNCHROTRON AT THE LAWRENCE RADIATION LABORATORY. H. Wade Patterson (Univ. of California, Berkeley). p.95-9 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

Calculation of shielding thickness should be compared with experimental data obtained with various detectors. Such data are presented for two accelerators. For the relatively well-shielded synchrocyclotron, emphasis is given to data that show how neutrons are attenuated in the primary shield and the composition of the remaining radiation field in areas close to the accelerator. For the Bevatron, which lacks a complete roof shield, data are given that show the distance dependence and the attenuation in concrete of neutrons that leave the machine in an upward direction. (auth)

22701 RESPONSE OF IONIZATION CHAMBERS TO HIGH ENERGY PULSED RADIATION FLUX. M. L. Corazza, M. Ladu, M. Pelliccioni, and E. Rotondi (CNEN, Frascati, Italy). p.101-3 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

The response characteristics of an ionization chamber to pulsed γ-radiation flux are studied. Pulse frequency and collecting voltage were modified, showing the variations of the saturation curves. (auth)

22702 A BASIS FOR CALCULATION OF DEPTH DOSE OF HIGH ENERGY PARTICLES. J. Neufeld and W. S. Snyder (Oak Ridge National Lab., Tenn.). p.105-7 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

The work done by Snyder and Neufeld on the depth dose curves in tissue equivalent material 30 cm thick irradiated by a broad beam of monoenergetic neutrons having various energies up to 10 Mev is extended to provide data for energies of incident neutrons (and protons) from 10 Mev into the Bev region. Simplified calculations are being performed in order to obtain approximate results within a relatively short time. More detailed results will be obtained. The data obtained from the study of a statistical nuclear model will be applied to a 30 cm slab of a tissue equivalent material in order to determine the absorbed dose (in rads) and the RBE dose (in rems) in accordance with the recommendations of the International Committee for Radiation Protection (ICRP) the relative biological effectiveness of ionizing radiation (RBE) is based on the linear energy transfer (LET). At the present time there is no theory that could be used as a basis for exact calculations of LET values for ions of hydrogen, oxygen, and nitrogen comprised within a significant energy region and released in tissue as a result of neutron bombardment. Neufeld and Snyder recently published data on LET values that are believed to be the most acceptable. These data are based on extensive new measurements and are the revision of calculations previously published in Radiation Research. The RBE corresponding to these revised data are being computed at the present time. (auth)

22703 HEALTH PHYSICS ACTIVITIES AROUND THE ORSAY LINEAR ACCELERATOR. G. Dardenne (Université de Paris, Orsay, France). p.111-17 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

The Orsay linear accelerator with traveling waves is designed for the acceleration of electrons to 250, 500, and 1000 Mev; the 250 and 500 Mev energies being obtained by beam deflection. It is anticipated that after modifications, the electron energy will be increased to 1300 Mev. Considerable health physics problems have been encountered. The main radiation source results from the photon-neutron cascades produced by the collision of electron beam with physical barriers such as targets and irises. However, klystron x rays and activation of copper irises located in the deflection tubes are significant secondary radiation sources. The first shielding design was based on the use of earth vertical walls, reinforced in hot areas by concrete blocks, and on the concept of accelerator partitioning. The protection against fast neutrons was inadequate and the secondary radiation sources were not taken into account. It was necessary to add supplementary shields. The 250 and 500 Mev target chambers are covered by water filled tanks; shielding of 1 and 1.3 Bev chambers and of irises is reinforced by earth and concrete screens. A lead sheath surrounds klystrons; and aluminum, instead of copper, is used in the irises of deflection tubes. (auth)

22704 HEALTH PHYSICS ACTIVITIES NEAR "INSTITUT DU RADIUM" SYNCHROCYCLOTRON. P. Bonet-Maury (Université de Paris, Orsay, France). p.119-21 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

A brief description of the health physics concepts around

the 157-Mev proton synchrocyclotron of Orsay is given. The synchrocyclotron and beam experimentation rooms are surrounded by a concrete shield. Personnel evacuation from these two rooms is necessary to operate the machine. Fast neutron and γ-ray, and fast neutron surveys are made in all the critical places, and the aerosols and radioactive gases activity is measured. For γ-ray monitoring, ionization chambers are used; and for fast neutrons determination Hurst proportional counters and tissue equivalent Failla Rossi chambers were chosen. C.E.A. film badges are worn by the personnel. Problems presented by the acceleration room target positioners and target induced radioactivity were resolved. (auth)

22705 INDUCED RADIOACTIVITY IN THE CERN ACCELERATORS. J. Baarli (CERN, Geneva). p.123-8 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In English)

Studies were carried out on the radiation caused by induced radioactivity in the CERN accelerators. They involve determination of the isotopes formed and their relative importance as to radiation safety. Build-up and decay of induced radioactivity are discussed with reference to experimental data. (auth)

22706 EFFECTS OF THE TARGET POSITION ON THE RADIATION FIELD NEAR SATURNE SYNCHROTRON. AUXILIARY TARGET UTILITY. P. Tardy-Joubert (CEN, Saclay, France). p.129-32 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

Since the Saturne synchrotron is not covered by a roof through the whole of its length, scattered radiation in the experimental hall and the control room changes greatly with target material and location. When thin targets are used, the dose rate can be reduced by greater distances between the target and the noncovered part of the accelerating chamber, and also by setting a thick auxiliary target at an adequate place. Experimental results are given. (auth)

22707 RADIATION MONITORING AROUND THE SATURNE SYNCHROTRON. SIMULTANEOUS MEASUREMENTS OF DOSE AND DOSE RATE. P. Tardy-Joubert (CEN, Saclay, France). p.133-6 of "Premier Colloque International sur la Protection Auprès des Grands Accélérateurs." Paris, Presses Universitaires de France, 1962. (In French)

Pulsed radiation monitoring presents some difficulties that can be solved by the use of integrating circuits. The charge delivered by the measured radiation is stored in a capacitor. The discharge of the capacitor when a reference charge has been stored and the use of a discharge number recording device are employed to estimate the dose received by the personnel. Dose rate is in direct ratio to the charge rate of the capacitor. Taking into consideration the time necessary to obtain, in the capacitor, the reference charge chosen (that is, to store a given dose), it is possible to rate the dose rate level with respect to reference levels. (auth)

22708 LINEAR ACCELERATOR. H. Heynisch (to Siemens & Halske A. G.). German Patent DAS 1,144,855. Mar. 7, 1963. Filed May 16, 1961.

A travelling-wave linear accelerator is described which consists of an iris-loaded cavity resonator. In the known accelerators of this type the distance between two irises is equal to one half wave length of the r-f. For very high particle energies these accelerators have to be quite long, because the breakdown voltage between the edges of neighboring irises limits the applied r-f voltage. In order to shorten the length of the waveguide it is therefore proposed to space the irises closer than one half of the guide wave length. (Gmelin Inst.)

22709 SYNCHROTRON RADIO FREQUENCY PHASE CONTROL SYSTEM. M. Plotkin, E. C. Raka, and H. S. Snyder (to U. S. Atomic Energy Commission). U. S. Patent 3,089,092. May 7, 1963.

A system for canceling varying phase changes introduced by connecting cables and control equipment in an alternating gradient synchrotron is presented. In a specific synchrotron embodiment twelve spaced accelerating stations for the proton bunches are utilized. In order to ensure that the protons receive their boost or kick at the exact instant necessary it is necessary to compensate for phase changes occurring in the r-f circuitry over the wide range of frequencies dictated by the accelerated velocities of the proton bunches. A constant beat frequency is utilized to transfer the r-f control signals through the cables and control equipment to render the phase shift constant and readily compensable. (AEC)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 21836, 21840, 21841, 21842, 21843, 21844, and 21845.

22710 (AD-282156) ELECTROMAGNETIC RADIATION IN MAGNETO-IONIC MEDIA FOR VLF AND VHF SPECTRA. Kenneth R. Cook (New Mexico. Univ., Albuquerque. Engineering Experiment Station). July 1962. Contract Nonr-2798(01). 125p.

A brief formulation of the fundamentals and salient features of the radiation of electromagnetic energy in a magneto-ionic medium is presented. Starting with the Maxwell-Lorentz theory of anisotropic media, a rather tutorial development terminates the formal solutions for the electromagnetic fields due to finite electric and magnetic current sources in such media. A set of potential functions for describing the electromagnetic fields of finite electric current sources is developed. Closed form solutions for the potential function are derived for both electric and magnetic dipoles in a homogeneous ionosphere by use of Fourier analysis and the associated Green's function. The determination of the radiation characteristics of an electric dipole arbitrarily oriented with respect to the static magnetic field or the gyrotropic axis of the magneto-ionic medium is examined with main emphasis on the field structure in the radiation zone. From the field structure the Poynting vector is determined for the VLF and the VHF spectra, and the net radiated power from the dipole. Radiation phenomena are compared with those for free space for the same dipole. The radiation properties of a magnetic dipole operating in the VHF and VLF spectra in or above the F-layer of the ionosphere are analyzed. Radiated power and radiation resistance are determined for each orientation of the dipole applicable to the VHF and VLF spectra. (auth)

22711 (AD-283041) THE USE OF LANGMUIR PROBES TO STUDY ION-ELECTRON RECOMBINATION. C. B. Kretschmer and H. L. Petersen (Aerojet-General Corp., Azusa, Calif.). July 1962. Contract AF49(638)-540. 36p. (AN-664)

Feasibility of using Langmuir probe measurements to

study ion-electron recombination in gas-discharge afterglows was examined. Theory for a negative probe with mobility-controlled ion motion was developed, and experiments were performed using various gases. Values of dissociative recombination coefficients obtained from pulse discharge afterglow measurements were: Ar, 3.6×10^{-7} for high excitation and 1.4×10^{-6} for intermediate excitation; N, 1.7×10^{-7}; O, 2.0×10^{-6}; Hg, 3.5×10^{-6}; and Cs, 1.7×10^{-7}. The frequency of three-body conversion of atomic to molecular ions at 1 mm Hg was found to be 151 sec^{-1} for Ar and 37 sec^{-1} for He. The charge exchange cross section for $N_2^+ + N \rightarrow N^+ + N_2$ is about 3×10^{-18} cm^2 at 0.04 ev. Probe measurements interpreted according to the derived theory are deemed to give results agreeing satisfactorily with microwave determinations. The theory is applicable in the pressure range of about 0.1 to 20 mm Hg. In this range, a negative probe does not appreciably disturb the plasma. 22 references. (auth)

22712 (AD-283078) INJECTION OF A TENUOUS PLASMA INTO A CUSPED MAGNETIC FIELD. Claude S. Leffel, Jr. (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). June 1962. Contract NOw 62-0604-c. 57p.

A Penning discharge plasma source was used to inject a tenuous plasma into a cusped magnetic field. Evidence is presented that indicates that the source ejects a plasma beam that is essentially neutral and that the plasma beam can be successfully injected into cusped fields as high as 20,000 gauss. Probe measurements, made within the cusped field yield plasma densities of the order of 10^{-3} cm^{-3} and electron temperatures of 20 to 30 ev. Attempts to measure plasma confinement times were inconclusive. The relationship of single-particle containment theory to this experiment is discussed. (auth)

22713 (AFCRL-62-555) LIGHT EMISSION CHARACTERISTICS DURING EARLY STAGES OF MICROWAVE PLASMA FORMATION. Final Report. J. J. Brady, A. R. Tynes, and M. F. Anderson (Oregon State Univ., Corvallis). Mar. 1962. Contract AF19(604)-5962. 45p. (AD-282971)

A spectrographic study of the light emission from pulsed microwave discharges in pure helium was undertaken to obtain the temporal behavior of individual spectral lines. The spectral time-resolution equipment used in the study has a spectral resolution of 0.1 Å in the first order and a time resolution of 5 nsec. The helium gas used is purified by uranium gettering, quartz diffusion, and cataphoretic separation. The impurity level is believed to be less than one part in 10^8. 29 references. (auth)

22714 (AFCRL-62-562) A KINEMATIC TREATMENT OF THE APPROACH TO EQUILIBRIUM IN A PLASMA. Scientific Report No. 2. S. Ichimaru (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). June 1962. Contract AF19(604)-7473. 18p. (AD-283089)

A set of kinematic equations are obtained from the Pines-Schrieffer formulation to describe the approach to equilibrium of electrons and collective oscillations in a plasma. The kinematic equations contain the conservation laws that the Pines-Schrieffer formulation satisfies. The kinematic formulation is applied to an analysis of the time-dependent behavior of a plasma that is unstable against a growing plasma wave. A close comparison is made with the analysis carried out by Drummond and Pines for a similar situation; the equivalence of the two treatments in a number of fundamental predictions is established. The role played by the spontaneous emission of plasma waves is also discussed. (auth)

22715 (AFCRL-62-574) NON-LINEAR TRANSPORT TECHNIQUES FOR DECREASING IONIZATION IN PLASMAS. Final Report. Robert M. Snow (Bay State Electronics Corp., Boston). July 27, 1962. Contract AF19 (628)-299. 36p. (AD-282916)

The feasibility of exploiting appropriate non-linearities in the mechanical response of electrons to radiation fields to alleviate a communications blackout is examined. Techniques whereby electrons are physically moved over significant distances by non-linear processes in the interaction of electrons with radiation are considered. A systematic perturbation procedure for calculating the important non-linear effects is developed. Calculations indicate that by irradiating a plasma with the appropriate types of electromagnetic field, significant transport effects can be obtained. The perturbation procedure is used for calculating such effects, leading to a "pseudostatic field" that acts primarily on electrons while essentially ignoring heavier particles. The pseudostatic field is a convenient artifice for the simplified description of dynamic trajectory effects; its status in this respect is strictly analogous to that of the classical Coriolis force. The feasibility of using this technique to convert disorderly electron motion to partially ordered motion is established. (auth)

22716 (D1-82-0238) CURRENT FLOW BETWEEN ELECTRODES IMMERSED IN A LOW GAS PRESSURE PLASMA. Melvin J. Kofoid (Boeing Scientific Research Labs., Seattle). Mar. 1963. 40p.

When electrodes are immersed in a low-density gas plasma, breakdown in the ordinary practical sense can not occur with an applied voltage less than the minimum of Paschen's curve. However, a leakage current can flow. The maximum circuit current will be numerically equal to the saturation positive ion current that flows from the plasma to the cathode. Attention is centered on the situation where one electrode has an area very much larger than the other. The difference in leakage current, as polarity is reversed, is then striking. The theory is discussed. The effects on the current vs voltage characteristics of changing the electrode area, electrode-area ratio, plasma ionization density, gas density, and gas were investigated experimentally. Practical expedients can greatly decrease the leakage current. (auth)

22717 (EDL-M488) SMALL AMPLITUDE ELECTROACOUSTIC PLASMA OSCILLATIONS. Robert A. Weir and A. F. Wickersham, Jr. (Sylvania Electric Products Inc. Electronic Defense Labs., Mountain View, Calif.). July 27, 1962. Contract DA-36-039-sc-89262. 6p. (AD-285146)

Electrostatic-acoustic disturbances will propagate with but slight-attenuation through an ionized medium, even if the medium includes high concentrations of neutral particles. Thus a propagation mode must exist in which most of the kinetic energy resides in the electrons, rather than the ions. A theory is obtained comprising both an ionic and an electronic mode, by deriving a set of differential equations that describe small amplitude, longitudinal, coherent oscillations in the plasma. Such a theory is briefly compared with recent observations. (auth)

22718 (IPPJ-6) EXPERIMENTS ON THE NEGATIVE RADIATION TEMPERATURE AT CYCLOTRON RESONANCE IN COLD PLASMA. Shigetoshi Tanaka, Kenji Mitani, and Hiroshi Kubo (Nagoya, Japan. Univ. Inst. of Plasma Physics). Feb. 1963. 31p.

The anomalous microwave radiation from a plasma in a magnetic field was observed. The intensity was extremely large compared with that of blackbody and amounted to the

power radiated from the plasma in the thermal equilibrium equivalent to 5.5×10^8 °K in the case of Kr and 1.5×10^6 °K in Xe. This radiation occurred very sharply at the cyclotron field, the width being one order smaller than that of normal cyclotron radiation. The radiation was observed in Xe, Kr, and Ar plasmas in the pressure range of $p = 1 \times 10^{-1} \sim 5$ mm Hg, but not in Ne and He plasmas at any pressure. Further, the radiation was observed when the whole tube was placed in a longitudinal magnetic field, but not when a part of the positive column was immersed in the field. The theoretical condition for a negative temperature at the cyclotron resonance in a weakly ionized gas was investigated. Whether this anomalous radiation could be interpreted as a phenomenon of the negative radiation temperature was discussed. 22 references. (auth)

22719 (IPPJ-8) AN EXAMPLE OF THE NON-ADIABATIC MOTION OF A CHARGED PARTICLE IN AN EXTERNAL MAGNETIC FIELD. Kazunari Ikuta and Tosiya Taniuti (Nagoya, Japan. Univ. Inst. of Plasma Physics). Mar. 1963. 6p.

Two particles of the same charge and with nearly equal initial momentums are shown to drift in opposite directions in certain magnetic fields varying steeply over a distance of the order of the cyclotron radius. (auth)

22720 (MMPP-235-1) KINETIC EQUATIONS FOR FULLY IONIZED, INHOMOGENEOUS PLASMAS. Richard K. Osborn (Michigan. Univ., Ann Arbor. Michigan Memorial-Phoenix Project). Aug. 1962. 55p.

Particle and photon transport in fully ionized gases is considered. Axioms for the description of such systems are presented and discussed; a balance relation for the particles in the plasma is derived; and a transport equation for photons is similarly developed. Implications of these balance relations for the thermodynamic state of plasma are examined, and an H-theorem for particle-photon systems is proved. The balance relations and the equations for the self-consistent electromagnetic fields derived are noted to represent generalizations and restrictions of the usual Boltzmann-Vlasor-Maxwell equations. (D.C.W.)

22721 (NASA-TN-D-1636) A THEORETICAL STUDY OF THE MOTION OF AN IDEALIZED PLASMA RING THROUGH VARIOUS TRAVELING-MAGNETIC-WAVE PLASMA ACCELERATORS. Clarence W. Matthews (National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.). May 1963. 21p.

The results of several computations of the motion of idealized plasma rings under the influence of several different traveling-magnetic-wave accelerators are presented and analyzed to show some of the theoretical phenomena that can occur in such accelerators. The results indicated that only a narrow range of magnetic-field and plasma-ring characteristics existed in which the plasma ring was confined within the accelerator. Slippage of the ring with respect to the field was observed in all the computations made. Comparison with available experimental data showed that almost an order-of-magnitude reduction in velocity resulted from experimental effects. (auth)

22722 (NASA-TN-D-1659) EXPERIMENTAL EVALUATION OF A DIRECT-CURRENT LOW-PRESSURE PLASMA SOURCE. Stanley Domitz (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1963. 34p.

A plasma source, consisting of a hot-filament coaxial discharge in an axial magnetic field, was operated with argon gas. The quantities measured in the plasma beam were the magnitude plus spatial distribution of electron temperature, number density and plasma potential. The plasma production efficiency is given as a function of the discharge parameters. The plasma beam was found to be up to 10 percent ionized with a minimum energy cost of 125 electron volts per ion, excluding filament and magnet power. (auth)

22723 (NP-12741) BACK SCATTERING OF A PLANE ELECTROMAGNETIC WAVE FROM AN INFINITE CYLINDER OF PLASMA WITH SMALL AXIAL GRADIENTS AND ARBITRARY RADIAL GRADIENTS OF ELECTRON DENSITY-NORMAL INCIDENCE. Technical Report No. 317. F. Lane, M. Abele, and S. Mariano (General Applied Science Labs., Inc., Westbury, N. Y.). Mar. 19, 1963. Contract NOrd 18053. 55p.

Scattering of plane electromagnetic waves normally incident upon cylindrical plasma structures with small axial gradients and arbitrary radial variations of electron density is examined. The case for an axially uniform plasma is reviewed, and determination of the scattered field is considered. Extension is made to the non-uniform case; methods for deriving the scattered field are discussed; and expressions for the scattered energy, particularly back-scattered, are derived. The back scattering cross section is also given. Results of a series of calculations of the cross section for a certain plasma configuration are presented and discussed. (D.C.W.)

22724 (NRL-5808) THERMAL IONIZATION OF ROCKET EXHAUST PLASMAS. W. W. Balwanz and B. N. Navid (Naval Research Lab., Washington, D. C.). July 30, 1962. 22p. (AD-282941)

Thermal or equilibrium processes contribute to the total ionization of the exhaust plasmas attending a missile in flight. Such equilibrium ionization is the principal contributor to the total ionization in some cases of interest. Calculations of the equilibrium values of ionization for various rocket-propellant components are presented in graphical form to make numeric values readily available and to simplify their utilization. (auth)

22725 (ORNL-TM-479) SOME APPLICATIONS OF MAGNETOHYDRODYNAMICS IN CONFINED VORTEX FLOWS. J. J. Keyes, Jr. (Oak Ridge National Lab., Tenn.). Feb. 28, 1963. Contract W-7405-eng-26. 48p.

The possibility that magnetohydrodynamic (MHD) interactions might be utilized advantageously for control and/or generation of high velocity confined vortex flows is considered. The cases surveyed in most detail are the hydrodynamically driven, MHD stabilized free vortex, analyzed previously by Chang, and the MHD driven and stabilized vortex, stability criteria for which are developed as an extension of Chang's analysis. In both cases idealized conditions of inviscid, incompressible, perfectly conducting flow are assumed. Preliminary numerical results suggest that, within the limitations imposed by the theoretical assumptions, stabilization of a hydrodynamically driven free vortex against turbulent breakdown due to small perturbations may be possible, using an axial magnetic field which, though relatively high, may be attainable in practice. Application to a H^+ plasma core fission reactor is discussed. Analysis of vortexes driven by interaction of applied axial magnetic and radial electric fields indicated that, while it is in principle possible to obtain stabilization under certain conditions, the electrical energy input required to maintain the radial electric current flow may be prohibitively high for plasma reactor ap-

plication. Analysis of the Hall effect for the case of a viscous, incompressible MHD driven vortex with finite electrical conductivity indicated that neglect of the Hall current term in the generalized Ohm's law expression will probably introduce negligible error for conditions of practical interest. Appreciable simplification of all subsequent MHD analysis is therefore possible. Recommendations for additional theoretical studies and for the initiation of an experimental program are discussed. (auth)

22726 (SIT-P91) CHALICE. EXPERIMENTAL INVESTIGATION OF CUSPED CONTAINMENT GEOMETRIES. Annual Report, 1962–1963. George Yevick (Stevens Inst. of Tech., Hoboken, N. Y.). Contract AT(30-1)-2582. 108p.

Research with the old main bank dealt with plasma bounce (observed at low voltages), studies of plasma in a high magnetic cusp field, observations of the Θ-pinch region, correlation of Θ-pinch with cusp, response of plasma to irregular current behavior, simultaneous observations of cusp and Θ-pinch with 1 μf preheater, end-on studies of plasma in the cusp region, and line escape. The results indicate that colliding plasmas mix thoroughly in the magnetic cusp region, that the walls of the cusp are good walls, that line escape is serious, and that radial instability grows rapidly in the Θ-pinch region. Higher magnetic fields may reduce line escape. Additionally, lack of early correlation between cusp and Θ-pinch was observed. Streak photographs taken in the course of the experiments are included. A Ring Chalice device, being constructed to help control line escape, is described. Defects in the transmission lines and switches hampered the utilization of the old main bank, and a new bank with higher efficiency and a faster rise time is being developed. Theoretical considerations in design of the bank and selection of its circuitry and geometry are discussed. Development and fabrication of very low inductance, high voltage transmission lines is reported. A 50 kv 10-kj switch was developed for use with the main bank. An inexpensive, quiet, simple air-gap switch, a method for rapid mapping of axially symmetric magnetic field lines with complicated boundaries, and a mobile 2.5-kj, 50-kv dynamic test bench were also devised. (D.C.W.)

22727 (TID-18540) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW DENSITY PLASMAS. Quarterly Progress Report, January 1 through March 31, 1963. (New York Univ., New York). Apr. 29, 1963. Contract AT(30-1)-2397. 7p.

Angular resolution of the apparatus used in beam-gas attenuation studies was tested and found sufficient. Expressions were derived for attenuation when the cross section does and does not depend on the relative velocity ($V_r^{0.4}$ dependence), and a study was made of the error induced by removing the cross section from the collision frequency integral and by using the average relative velocity dependence of the cross section. The approximation was found valid to within 2.2%. A model of the plasma chamber was tested at temperatures up to 2700°K. Pressure varied from 4×10^{-6} when the chamber was cold to 1×10^{-5} with hot plasma. The Cs triode was operated as an a-c amplifier, giving amplification of 7 and 1.5 at 30 and 3,000 cps. An unsuccessful search was made for fast neutrals due to charge exchange. (D.C.W.)

22728 (UCRL-Trans-945(L)) OSCILLATIONS OF A WEAKLY HETEROGENEOUS PLASMA. V. P. Silin (Akademiya Nauk S.S.S.R. Institut Fiziki im. P. N. Lebedeva). Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from report A-210. 1962. 21p.

The natural oscillations of a weakly heterogeneous plasma are studied. The dispersion equations that define the eigen frequencies of such oscillations are analogous to the quasi-classical principles of Bohr's quantization. Using such dispersion relations, the high-frequency electron oscillations are analyzed for a weakly heterogeneous plasma. The quantization principles are likewise used to study the oscillation spectrum of a weakly heterogeneous plasma contained by a strong magnetic field. Sufficient conditions for plasma instability are derived and analyzed for several cases. (auth)

22729 INTERACTION OF HIGH-CURRENT BEAMS WITH THE PLASMA IN A MAGNETIC FIELD. A. K. Berezin, G. P. Berezina, L. I. Bolotin, and Ya. B. Fainberg. At. Energ. (USSR), 14: 249-56(Mar. 1963). (In Russian)

It was shown that the passage of an originally unmodulated electron beam through a homogeneous plasma excites longitudinal oscillations in it; the E and H waves in the plasma may also interact simultaneously with the beam. Such interactions of a 8.5-amp and 15-kev electron beam placed in a magnetic field which was varied from 360 to 132 oersted were investigated. The energy distribution of the electrons after the passage of the beam through the plasma was determined as a function of the beam current, pressure of the residual gas, and the strength of the longitudinal magnetic field. The strengths of the transversal and longitudinal high-frequency fields generated within the plasma were measured. It was found that they reach about 100 v/cm and 1 to 2 v/cm, respectively. The results indicated that the large energy losses of the beam during its passage through the plasma are due to the excitation of high-frequency oscillations. (TTT)

22730 COHERENT INTERACTION OF AN ELECTRON BEAM WITH PLASMA. I. F. Kharchenko. At. Energ. (USSR), 14: 314-15(Mar. 1963). (In Russian)

It was shown previously that interaction of an electron beam with plasma reinforces the oscillations with a frequency close to the plasma frequency; this is accompanied by coherent energy losses. These losses of the energy of a modulated electron beam passing through the plasma were measured by means of an electrostatic analyzer and a phase analyzer with a resolution of 0.2 to 0.4% of the original beam energy. It was found that the losses are due to an increase of the longitudinal regulating oscillations in the plasma to a frequency level causing the magnification of the high-frequency component of the beam; as a result of this, the current is scattered on these oscillations. The distribution of the density was found to be nonuniform with respect to the radius. If the duration of the interaction is short, the amplitude of the high-frequency field is low and no coherent interaction can be observed. (TTT)

22731 EXPERIMENTAL STUDY OF FREE OSCILLATIONS, IN A U TUBE WITH RECTANGULAR CROSS SECTIONS, OF AN ELECTROCONDUCTIVE LIQUID IN THE PRESENCE OF A MAGNETIC FIELD. Étienne Crausse, Yves Poirier, and Charles Vivès (Laboratoire de Physique Industrielle, Faculté des Sciences, Algiers). Compt. Rend., 256: 2291-3(Mar. 11, 1963). (In French)

An experimental study was made of the free oscillations in a vertical U tube with rectangular cross section of a heavy, viscous, electroconductive liquid in the presence of a uniform magnetic field perpendicular to the flow. Curves represent the time evolution of the mean velocity for different field values. (tr-auth)

22732 LAMINAR, PLANE FREE JET OF AN INCOMPRESSIBLE FLUID IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. René Moreau (Université,

Grenoble, France). Compt. Rend., 256: 2294-6(Mar. 11, 1963). (In French)

It is shown that an affinity solution exists for an arbitrary distribution of the magnetic field. (tr-auth)

22733 LONGITUDINAL DIELECTRIC CONSTANT OF A PLASMA, CONTAINING THE EFFECT OF CORRELATIONS. Jean Coste. Compt. Rend., 256: 2329-30(Mar. 11, 1963). (In French)

The longitudinal dielectric constant of a plasma, containing the effect of correlations, is obtained from Guernsey's kinetic equation. (tr-auth)

22734 MOVEMENT IN SPACE OF A PERFECTLY CONDUCTING COMPRESSIBLE FLUID. Lazare Dragos (Université, Bucharest). Compt. Rend., 256: 2524-7 (Mar. 18, 1963). (In French)

The movement of a perfectly conducting compressible fluid in the presence of a thin profile was studied in linearized theory for a tridimensional space. (J.S.R.)

22735 STUDY OF A BIDIMENSIONAL FLOW WITH NONALIGNED FIELD. Roger Thibault. Compt. Rend., 256: 2528-31(Mar. 18, 1963). (In French)

The hodographic method was extended to the study of the flow of a conducting fluid around a cylindrical obstacle when the magnetic field and the fluid velocity have infinitely colinear projections on a plane perpendicular to the generatrices of the obstacle. (tr-auth)

22736 STUDY OF A STRONGLY IONIZED PLASMA OBTAINED IN A CROSSED CATHODE DISCHARGE. Jean-Claude Boulassier and Jean Cuvellier. Compt. Rend., 256: 2567-70(Mar. 18, 1963). (In French)

The experimental conditions for the ignition and maintenance of the arc regime are indicated. The principal measurements on the behavior of the plasma itself are summarized and discussed briefly. (tr-auth)

22737 STABILIZATION OF THE "UNIVERSAL" INSTABILITY OF THE SLIGHTLY NONHOMOGENEOUS PLASMA BY RELATIVISTIC ELECTRONS IN A MAGNETIC FIELD. G. M. Zaslavskiĭ (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR, 148: 803-5(Feb. 1, 1963). (In Russian)

L. I. Rudakov and R. Z. Sagdeev (Doklady Akad. Nauk SSSR, 138: 581(1961)) showed that in the rarefied, nonhomogeneous plasma contained by a magnetic field the local nonmagnetic perturbations generate an instability which is not correlated with the structure of the magnetic field. It was found later that this instability has a "universal" character, i.e., it does not depend on the relation between the temperature and density gradients. This problem was further considered for the case of a plasma containing nonrelativistic ions and relativistic electrons; in that case the electron Larmor radius is identical with the ionic radius and calculation of its finite character may lead to the stabilization of the plasma with respect to "universal" instability. It was assumed that the plasma pressure is lower than the magnetic pressure, the system is quasilinear, and the time of the collisions is quite large. The calculations indicated that the presence of the relativistic electron components in the nonhomogeneous plasma points out the nonuniversal character of the instability generated in the longitudinal oscillations. (TTT)

22738 EXPERIMENTS ON PLASMA OSCILLATIONS. A. Garscadden (Queen's Univ., Belfast). J. Electron. Control (1), 14: 303-14(Mar. 1963).

Some new experiments are described and discussed on plasma-electron oscillations excited by a low-voltage electron beam in a low-pressure gas. The experiments were on the production of standing waves, with frequency pulling by reflex action of the anode, including effects of secondary emission from the anode; discharges from a matrix cathode; transverse fields; and the relation between the oscillations and the electron energy distribution, found tentatively by the Druyvesteyn method. (auth)

22739 UTILIZATION OF A DUOPLASMATRON AS AN ELECTRON SOURCE OF VERY HIGH SPECIFIC EMISSIVITY. Guy Gautherin and Albert Septier (Institut d'Electronique, Orsay, France). J. Phys. Radium, 23: Suppl. No. 12, 212A-13A(Dec. 1962). (In French)

Within the framework of a study of ion sources of the duoplasmatron type, it was shown that, if the arc parameters (pressure, arc current, and magnetic induction) are fixed, this source will furnish a constant ion current. The ion and electron emission of this source were compared. The total electron current extracted is almost independent of the extraction voltage, if the other parameters are held constant. It is shown that the current increases with the magnetic induction, arc current, and diameter of extraction diaphragm. The study of the spectrum of the electron velocities showed that the extracted electrons have a mean velocity which increases with the arc current and with the magnetic induction. The spectrum length was of the order of 10 v. Therefore, the duoplasmatron can be used as an electron gun with high emissivity. (J.S.R.)

22740 HIGH-FREQUENCY CONDUCTIVITY OF QUANTUM PLASMA IN A MAGNETIC FIELD. Carl Oberman and Amiram Ron (Princeton Univ., N. J.). Phys. Rev., 130: 1291-4(May 15, 1963).

The problem of the electromagnetic absorption coefficient in a quantum plasma in the presence of a uniform magnetic field is investigated by a kinetic description. The finite duration of encounters is taken into account in a self-consistent fashion which includes collective effects properly. This treatment is the quantum extension of an earlier classical study. The application of this theory to heavily doped semiconductors is suggested. (auth)

22741 IONIZATION PROCESSES IN DECAYING PLASMAS. I. HELIUM. Howard Myers (Aerospace Corp., El Segundo, Calif.). Phys. Rev., 130: 1639-43 (June 1, 1963).

The current theories of the helium afterglow are shown not to be substantiated by published experimental results. The experimental data are reanalyzed to obtain a more consistent interpretation of the ionization mechanisms. The primary conclusion of this analysis is that the enhancement of ionization in the afterglow occurs by the conversion of metastable helium atoms to molecular ions: $He^* + He^* \rightarrow He_2^+ + e$. The analysis yields specific rate constants for the important reactions in the plasma. (auth)

22742 RADIATIVE TRANSFER OF DOPPLER BROADENED RESONANCE LINES. A. G. Hearn (Culham Labs., Abingdon, Berks, Eng.). Proc. Phys. Soc. (London), 81: 648-62(Apr. 1, 1963).

The radiative transfer of Doppler broadened resonance lines in a plasma that is not in local thermodynamic equilibrium is studied for a simple model of an infinite, uniform plane parallel plasma. A two-level atomic model is used in which electrons are transferred between the levels by electron excitation and de-excitation, spontaneous emission and photo-excitation. Stimulated emission is neglected. It is assumed that the source function is independent of frequency and that the spontaneous emission

is isotropic and unpolarized. The radiation is emitted in a Doppler broadened profile in which natural and pressure broadening may be neglected. In the calculations the population of the excited level is assumed to be much smaller than the ground level. The distribution of excited atoms in a steady state with their own resonance radiation was calculated, and from this the rate of energy loss, and the line profiles and intensities are obtained. The rate of energy loss is compared with a model of photon diffusion in frequency space. The line profiles are self-reversed although the calculations are for a uniform plasma. The validity of the assumptions is examined and the restrictions they place on the range of application are considered with particular reference to Lyman α radiation. (auth)

22743 SCATTERING FROM A BOUNDED PLASMA. G. H. Bryant and R. N. Franklin (Royal Military Coll. of Science, Swindon, Wilts, Eng.). Proc. Phys. Soc. (London), 81: 790-2(Apr. 1, 1963).

Theoretical expressions for the scattering from a bounded plasma column placed centrally across a rectangular waveguide are investigated. A complete solution is obtained by introducing electric field modes in the scattered and internal fields and matching two magnetic and two electric fields at the plasma boundary. The reflection coefficient is corrected for the new solution. (C.E.S.)

22744 ON THE POSSIBILITY OF LOCATING THE BOUNDARY OF A PENETRATING PLASMA BY A BEAM OF CHARGED PARTICLES. M. D. Gabovich, O. O. Lozova (Lozovaya), and L. I. Romanyuk (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 7: 59-60(Jan. 1963). (In Ukrainian)

The possibility of determining the configuration of the boundary of a plasma penetrating from an ion source into a vacuum region free from magnetic field by means of a beam of electrons is shown. (auth)

22745 DIFFUSION IN AN INHOMOGENEOUS RAREFIED PLASMA DUE TO EXCITATION OF "ION-ACOUSTIC" OSCILLATIONS. V. D. Shapiro (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 7: 1033-45 (Feb. 1963). (In Ukrainian)

Methods of the quasilinear theory of plasma stability were used to determine saturation amplitudes and spectral-acoustic oscillations in an inhomogeneous plasma in a strong magnetic field. The full energy of ion-acoustic oscillations at the saturation stage proved less than that of the thermal motion of the electrons of the plasma by a value of the order of $(m^e)/(m^i)^2/(u_0)/(\nu_{T_e})$ (where m^e, m^i are the masses of the electrons and ions u_0 and ν_{T_e} are the average and thermal velocity of the electrons). The current of particles across the magnetic field due to excitation of ion-acoustic oscillations is computed. The current in a direction perpendicular to the magnetic field and the gradient of density and temperature, giving rise to diamagnetism of the plasma, and the diffusion current in the direction of the gradient were measured. The ratio of the diffusion due to the excitation of the oscillations under consideration to the diffusion coefficient due to paired collisions proved to be of the order of $(m^e)/(m^i)^2/(u_0)/(\nu_{T_e})\ N_D$: (where N_D is the number of particles in a Debye sphere). $N^D \gg 1$; however, since $(m^e)/(m^i) \sim 10^{-3}$ the ratio $(D^{(osc)})/(D^{(\alpha)})$ cannot be very great. Under stellarator conditions the value of the diffusion due to excitation of ion-acoustic oscillations is 4–6 orders less than the experimentally observed diffusion and, therefore, the anomalously short lifetime of plasma in the stellarator cannot be explained by excitation of ion-acoustic oscillations. (auth)

22746 DIFFUSION OF CHARGED PARTICLES OF PLASMA IN MAGNETIC FIELD. V. E. Golant. Usp. Fiz. Nauk, 79: 377-440(Mar. 1963). (In Russian)

The theory of stable plasma diffusion is discussed, and basic experimental data on diffusion in magnetic fields are surveyed. The analysis of experimental data showed that in many cases the diffusion of charged particles across a strong magnetic field is much faster than predicted by theory. In the presence of currents in the plasma or with strongly directed particle motion (in positive discharge cylinder, in discharge with oscillating electrons, and in strongly ionized plasma) the diffusion agrees with the theoretical prediction only for small magnetic fields. With larger fields the diffusion rate is faster. The observed abnormally fast particle transport across magnetic fields was accounted for in the development of instabilities, oscillations, and noises. 122 references. (R.V.J.)

22747 QUANTITATIVE INVESTIGATION OF THE POWER BALANCE OF A COMPLETELY IONIZED He PLASMA. Jacques Durand (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 18a: 281-99 (Mar. 1963). (In German)

The temperature ($T = 3$ to 4×10^4°K) and the electron density ($N_e = 2$ to 11×10^{16} cm^{-3} of a stationary completely ionized He plasma were measured in different ways. It is shown that the plasma exists in local thermal equilibrium. In addition the temperature and density gradients were determined. The heat loss of the plasma calculated from the variable quantities and their gradient was compared with the measured addition to the electric energy. It was not necessary for explanation of the energy removal of refer to processes other than the classical heat conduction and radiation losses. (tr-auth)

22748 MASS SEPARATION AND CONSTRICTION EFFECTS IN h–f PLASMA. H. Rother (Forschungslaboratorium der Siemens & Halske A. G., Munich). Z. Naturforsch., 18a: 300-8(Mar. 1963). (In German)

The drift of ions in a high-frequency ring discharge was calculated. Under characteristic resonance conditions strongly mass-dependent rectified radial ion currents originated. The related mass-separation effects corresponded to a mechanical mass centrifuge. A calculation of ion drift in high-temperature plasma after irradiation by microwaves transversal to a static magnetic field with disregard for hydromagnetic effects is given. Maximal radial equi-drift originated in the surroundings of the cyclotron resonance and to be sure as suction to the plasma surface for frequencies ω below and directly above the cyclotron frequency Ω_0. A drift in the plasma interior (constriction) came about when $(\omega - \Omega_0)$ amounted to a multiple of the reciprocal of stopping time of an ion in the effective region of the high-frequency field. (tr-auth)

22749 ELECTRIC PROBE MEASUREMENTS IN FAST CURRENT INTENSITY SHOCK DISCHARGES. Guenter Hofmann (Technische Hochschule, Munich). Z. Naturforsch., 18a: 309-17(Mar. 1963). (In German)

In hot dense plasmas, as in the case of shock discharges, Langmuir probe measurements are difficult because complete probe characteristics are mostly unobtainable. Therefore, the possibility of getting information about the plasma at low probe voltages is demonstrated. It is shown that for a sufficiently small probe voltage the current drawn by a symmetrical plane double probe is proportional to $n_i/\sqrt{T_e}$ (n_i = ion density, T_e = electron temperature). Knowing the approximate value of the electron temperature, the probe current gives the ion density immediately. Also the di-

rected motion of ions can be determined by changing the orientation of the probe. A good time resolution (10^{-7} sec) was achieved by matching the impedance between the probe and the plasma to the coaxial probe circuit. The usefulness of this probe technique was investigated in a linear shock discharge with a coaxially, circular, plane double probe. Ion densities up to 10^{15} cm^{-3} and directed ion velocities of some 10^5 cm/sec were observed. Simultaneously the electrode voltage, current derivative, and the local azimuthal magnetic field in the plasma were measured. (auth)

22750 INVESTIGATION OF SHOCK AND LUMINOUS FRONTS IN AN ELECTROMAGNETIC SHOCK TUBE. P. Jeanmaire, H. Klingenberg, and H. Reichenbach (Ernst-Mach-Institut, Freiburg i. B.). Z. Naturforsch., 18a: 318-22(Mar. 1963). (In German)

The processes in an electromagnetic shock tube (T-tube) were investigated with drum camera, Kerr cell camera, and multipliers. From a great number of drum camera photographs and average path-time curve for the luminous phenomena for pressures from 0.02 to 50 torr was obtained. At higher pressures a separation of the weakly luminous shock front from the real luminous front was observed. Kerr cell photographs showed an uneven structure in the luminous front which is regarded as the contact front, that is, the gas behind this front is heated by means of the discharge. For this front therefore the Rankine-Hugoniot equation could not therefore be used directly, as frequently assumed, especially not at lower pressures at which the shock front and luminous front coincide. The equation is valid only for the separated shock front, in case for T-tubes an already differently observed excitation of the gases before the shock front are also considered. (tr-auth)

22751 THE TIME PATTERN OF THE ELECTRON DENSITY IN PHOSPHORESCENT NITROGEN PLASMA. F. Doebler (Technische Hochschule, Brunswick). Z. Naturforsch., 18a: 431-(Mar. 1963). (In German)

The variation of electron density with time in the auroral afterglow of decaying nitrogen plasma at 2.5 torr was determined. The excitation strength of the discharge was varied. The time variation in electron density was found to be very similar to the optical emission. (M.C.G.)

22752 OSCILLATIONS OF WEAKLY INHOMOGENEOUS PLASMA. V. P. Silin (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1271-82(Apr. 1963). (In Russian)

The natural oscillations of a weakly inhomogeneous plasma are studied. The dispersion equations that define the natural frequencies of such oscillations are anagolous to the quasi-classical Bohr quantization laws. With help of the dispersion equations high frequency electron oscillations of a weakly inhomogenous plasma are considered. The quantization rules are also employed for studying the oscillation spectrum of a weakly inhomogeneous plasma confined by a strong magnetic field. Sufficient conditions for instability of the plasma are deduced and, in some concrete cases, analyzed. (auth)

22753 STATIONARY PLASMA FLOW IN A MAGNETIC FIELD. A. P. Kazantsev (Inst. of Radiophysics and Electronics, Academy of Sciences, Siberian SSR). Zh. Eksperim. i Teor. Fiz., 44: 1283-8(Apr. 1963). (In Russian)

An isolated wave of finite amplitude moving in a cold plasma at an arbitrary angle to the magnetic field is considered. It is shown that the waves may be of three types: large-scale compression pulses (Alfven waves), rarefaction pulses (magnetoacoustic waves), or small-scale compression pulses corresponding to high frequency magnetoacoustic oscillations. The wave amplitude dependence on Mach number is established. The critical magnetic field amplitude for compression waves near which the solution becomes unstable is also found. (auth)

22754 EXCITATION OF ION-ACOUSTIC WAVES AND HEATING OF ELECTRONS IN A PLASMA BY AN EXTERNAL ELECTRIC FIELD. Yu. B. Ponomarenko. Zh. Eksperim. i Teor. Fiz., 44: 1289-97(Apr. 1963). (In Russian)

A plasma with cold ions in a strong external time-periodic electric field is considered. The mechanism of electron heating without particle collisions is analyzed. The heating mechanism consists of the following: under the action of the external electric field the electrons acquire a velocity with respect to the ions; ion-acoustic waves are then excited and tend to smooth out the electron distribution function. In a periodic electric field this smoothing process is repeated, and as a result the electron distribution function is smoothed out in a velocity range corresponding to the doubled velocity acquired by the electrons in an external field. (auth)

22755 SMEARING OUT OF INHOMOGENEITIES IN A WEAKLY IONIZED PLASMA IN A MAGNETIC FIELD (AMBIPOLAR DIFFUSION). A. V. Gurevich (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1302-6(Apr. 1963). (In Russian)

It is demonstrated that the smearing out of an inhomogeneity in a plasma, called ambipolar diffusion, is of a complex nature in a magnetic field and cannot be described by the usual diffusion equation. The velocity of the inhomogeneity across the magnetic field significantly depends on the initial size of the inhomogeneity. It may exceed the transverse electron diffusion velocity by several times. (auth)

22756 DIFFUSION OF PLASMA CHARGED PARTICLES IN A STRONG MAGNETIC FIELD AFFECTING PARTICLE COLLISIONS. V. E. Golant (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 3-18(Jan. 1963). (In Russian)

Diffusion of charged particles across a magnetic field was studied using various ratios of Larmor and Debye radii. Expressions are obtained for determining diffusion fluxes. (tr-auth)

22757 ON THE RADIATION OF AN ELECTRON MOVING ALONG A SPIRAL IN MAGNETOACTIVE PLASMA. [PART] II. V. I. Pakhomov and K. N. Stepanov (Khar'kov Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 33: 43-50 (Jan. 1963). (In Russian)

Magneto-restricted, basic-frequency electron emission in high-density plasma was investigated. Expressions were obtained for the intensity of a single electron emission and for the plasma emission and absorption frequency close to the electron gyro frequencies. (tr-auth)

22758 ELECTRON BEAM INTERACTIONS WITH PLASMA IN MAGNETIC FIELD. I. LONGITUDINAL OSCILLATIONS. E. A. Pashitskii. Zh. Tekhn. Fiz., 33: 51-7(Jan. 1963). (In Russian)

A hydrodynamic approximation was used for resolving the non-linear problem of relativistic electron beam interactions with plasma in a magnetic field. It is shown that for small non-linearity stationary solutions in the form of traveling waves with constant amplitude (a = const) can be found for longitudinal oscillations. The non-linear effects induce high harmonic oscillations and amplitude dependence on frequency. (tr-auth)

22759 ELECTRON BEAM INTERACTIONS WITH PLASMA IN MAGNETIC FIELD. II. TRANSVERSE OSCILLATIONS. E. A. Pashitskii. Zh. Tekhn. Fiz., 33: 58-64(Jan. 1963). (In Russian)

Non-linear interactions between a monoenergetic nonrelativistic electron beam and a plasma in a magnetic field were analyzed using hydrodynamic approximation. It was shown that under certain conditions the non-linear interactions of transverse and longitudinal oscillations result in a transfer of energy from the beam excited longitudinal oscillations to the transverse oscillations, causing instability in the system. Various cases of instability were analyzed, and the increments of increasing transverse oscillations were found. (tr-auth)

22760 PROBLEMS IN MAGNETOGASDYNAMICS OF QUASI ONE-DIMENSIONAL PLASMA. [PART] II. V. S. Erofeev and Yu. V. Sanochkin. Zh. Tekhn. Fiz., 33: 73-9 (Jan. 1963). (In Russian)

The problem of one-dimensional plasma flow in crossed electric and magnetic fields was studied in magnetogasdynamic approximation for the case in which $Re_m \gtrsim 1$. Various flow regions were analyzed and the sonic barrier transitions were found. Formulas were obtained for quasi-one-dimensional isothermal plasma flow in a constant cross-section channel. (tr-auth)

22761 ON THE STRUCTURE OF MAGNETOHYDRODYNAMIC WAVES OF FINITE AMPLITUDE IN A COLD COLLISIONLESS PLASMA. Theodore Alexander Wilson. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 33p.

Properties of the two-fluid plasma equations which lead to a partial theoretical model for the collisionless shock wave are investigated. First, a non-linear symmetric-pulse solution to the collisionless two-fluid equations is described. The propagation speed of the pulse is between the Alfven speed and the fast wave speed, and the pulse thickness is of the order of $(m_i c^2/4\pi e^2 N)^{1/2}$, except for geometries in which the wave normal makes an angle of the order of $(m_e/m_i)^{1/2}$ or less with the upstream magnetic field. An effective conductivity is then introduced in the equations of motion of the plasma, and a shock thickness is estimated. The calculated dependence of shock thickness on Mach number is shown to agree with Patrick's experimental data. Finally, the growth of a sinusoidal pinch instability of a current-carrying plasma is shown to have the average effect of a finite conductivity as was postulated. (Dissertation Abstr.)

22762 RELATIVISTIC TRANSPORT EQUATIONS FOR PLASMAS. Ercuement Oezizmir. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 84p.

A quantum-mechanical formulation of transport equations appropriate to high temperature plasmas is developed. The dynamical description of the system is based upon the second-quantized Dirac theory of electrons. For the study of the statistical aspects, an invariant phase-space distribution function is introduced, which is analogous to the Wigner distribution function and which is suitable to the study of the spin-1/2 particles described by the Dirac equation. Transport equations are derived in the "self-consistent field" approximation, which account for the spin effects on the transport and which reduce to the covariant form of the usual Vlasov equation as $\hbar \to 0$. A relativistic Boltzmann equation is derived for a system consisting of electrons, positrons, and photons in the absence of any external fields. The derivation proceeds via a Pauli type equation (Master equation) and employs the S-Matrix formalism to the second order in the perturbation analysis. The resulting equations account for pair creation and annihilation, spin effects, and particle statistics (Einstein-Bose or Fermi-Dirac). An H-Theorem is proved, and equilibrium distributions are displayed for the system under consideration. It is shown that the processes described to the second order in perturbation analysis completely determine the equilibrium solutions. The results are in agreement with those obtained from thermodynamical considerations and indicate that, at very high temperatures ($kT \sim mc^2$), there would be a considerable number of electron-positron pairs in the system. A dispersion relation is given for transverse oscillations in a relativistic plasma, which, in the non-relativistic limit, reduces to that given by Bohm and Pines with an additional term due to spin. (Dissertation Abstr.)

22763 NONLINEAR RESPONSE OF PLASMAS TO ELECTROMAGNETIC WAVES AND SURFACE WAVE PROPAGATION IN MAGNETO PLASMAS. Joseph Thomas Verdeyen. Thesis, Urbana, Ill., Univ. of Illinois, 1962. 192p.

The nonlinear interaction of an r-f electromagnetic wave and a plasma, which is characterized by the generation of electromagnetic power at frequencies harmonically related to the applied frequency, is studied theoretically and experimentally. The various plasma mechanisms that are responsible for this nonlinear behavior are identified and analyzed. One particular mechanism is analyzed in detail, and experiments which are designed to verify this detailed analysis are described. Good agreement between theory and experiment is obtained. Closely related to the nonlinear study is the topic of propagation of electromagnetic waves in a plasma. It is found that there is a mode of propagation in a bounded magneto plasma, which can be classified as a surface wave. This mode exhibits a non-reciprocal behavior similar to the effect found in a ferrite field displacement isolator. The relationship of the propagation constant and the field configuration of this mode to the plasma parameters is studied. Theory and preliminary experimental results are in qualitative agreement. (Dissertation Abstr.)

22764 DUO-PLASMATRON LENS PULSER (Engineering Materials). (Oak Ridge National Lab., Tenn.) 6 drawings. (CAPE-876)

The lens pulser is used in controlling the plasma which is the source of particles in the van de Graaff generator. Drawings are included for Models I, V, and VI of the CERN Lens. (F.L.S.)

22765 CONFINEMENT OF HIGH TEMPERATURE PLASMA. H. R. Koenig (to U. S. Atomic Energy Commission). U. S. Patent 3,088,894. May 7, 1963.

The confinement of a high temperature plasma in a stellarator in which the magnetic confinement has tended to shift the plasma from the center of the curved, U-shaped end loops is described. Magnetic means are provided for counteracting this tendency of the plasma to be shifted away from the center of the end loops, and in one embodiment this magnetic means is a longitudinally extending magnetic field such as is provided by two sets of parallel conductors bent to follow the U-shaped curvature of the end loops and energized oppositely on the inside and outside of this curvature. (AEC)

Shielding

22766 (PA-TR-3009) PLASTIC MATERIALS IN LIGHTWEIGHT NEUTRON SHIELDS; GENERAL THEORY AND PRACTICE. J. J. Begley (Picatinny Arsenal. Felt-

mann Research Labs., Dover, N. J.). Aug. 1962. 38p. (AD-284982)

A quick, simplified review is presented of the neutron shielding process and general criteria for determining the relative effectiveness of various shielding materials are described. Among these criteria are hydrogen density, the presence of neutron-absorbing materials, and secondary gamma emitters. A graph is presented whereby the hydrogen density of a material can be rapidly determined. Various shielding materials and fabrication techniques are reviewed, with particular attention to the highly promising cast-in-place method. A list of the major resins and other plastic materials and their relative shielding values is presented. Inspection techniques are discussed as a quality control measure to ensure void-free sections. (auth)

22767 DETERMINATION OF THE BUILDUP FACTOR FOR BARRIER GEOMETRY. L. R. Kimel. At. Energ. (USSR), 14: 315-16(Mar. 1963). (In Russian)

Tabulations of numerical values of the coefficients appearing in the formula which determine the buildup factor, while taking into account the effect of multiple scattering, are available for various γ-energy levels and for several different shielding materials. The formulas refer to ideal cases, but in actual calculations instead of infinite media shielding barriers of a finite thickness must be used. This makes it necessary to make use of a correction factor when recalculating the numerical values derived for an infinite medium. Attempts to express this factor as a sum of two exponents did not yield satisfactory results. The ratio of the buildup factors for barrier geometry and for an infinite medium were assumed to be constant, without reducing the precision of the calculations. It was thus possible to use the buildup factor calculated for infinite medium for calculating the dose from large sources placed behind a shield. The values of these coefficients for water and iron are presented in a tabular form; they may be used advantageously for calculations involving isotopic point sources. (TTT)

22768 ISMES-SORIN JOINT RESEARCH ON SHIELDING STRUCTURES. EFFECT OF AGGREGATE GRADING ON THE SHIELDING EFFECTIVENESS OF SPECIAL CONCRETE FOR GAMMA RADIATIONS. Aldo Ascari and Rita Somigliana (Centro Ricerche Nucleari, SORIN, Saluggia, Italy). Energia Elettrica, 39: 688-92(Aug. 1962). (In Italian)

The variation of aggregate grading in a special barytic concrete used as shield against gamma radiations results in a variation of heterogeneity degree and therefore in a different dispersion of single determinations of each quantity suitable to evaluate the properties that reduce the shielding effect of the medium. This effect, which can be foreseen in a qualitative way, was confirmed by suitable measurements subjected to statistic analysis, and a quantitative characterization was obtained. The possibility of setting up an empirical correlation between characteristic parameters of the grading and of the dispersion was also examined. (auth)

22769 SHIELDING AGAINST SPACE RADIATION. Richard Madey (Republic Aviation Corp., Farmingdale, N. Y.). Nucleonics, 21: No. 5, 56-60(May 1963).

A discussion of the problems in space radiation shielding is presented. The problem of penetrating protons is considered in an attempt to illustrate the physical shielding requirements for manned vehicles and to illuminate some of the gaps in present knowledge. Material and magnetic shielding are considered. (C.E.S.)

Theoretical Physics

22770 SOME MATHEMATICAL ASPECTS OF THE LIPPMANN-SCHWINGER EQUATIONS IN NON-RELATIVISTIC QUANTUM MECHANICS. H. Caprasse (Université, Liege). Bull. Soc. Roy. Sci. Liege, 32: 78-86(1963). (In French)

Some questions related to the field of validity of the equation: $(E - H_0)/(E - H_0 \pm i0)\, V|\Psi \pm > = V|\Psi \pm >$ occurring in the Lippmann-Schwinger scattering theory are investigated. In connection with these problems it is shown that if the potential satisfies a certain condition, the Schrödinger's equations in $\vec{r}$-space and in $\vec{p}$-space are mathematically equivalent. (auth)

22771 A LORENTZ-INVARIANT UNIVERSE WITH CHARGE EXCESS. Ll. G. Chambers (University Coll., North Wales, Bangor). Nature, 198: 379-80(Apr. 27, 1963).

The Lyttleton-Bondi hypothesis that the expansion of the universe is caused by the absolute values of the charges of the proton and electron not being equal, thereby giving a net charge to the hydrogen atom and causing mutual repulsion in the universe which may be considered as composed of a uniform distribution of hydrogen atoms was examined. Watson's creation potential and Maxwell's equations were used to determine the creation rate. Inspection of the theory shows that the 4-vector defined by electric current and charge is not Lorentz invariant. (C.H.)

22772 A MACROSCOPIC REAL QUANTUM THEORY. Helmut Schmidt (Universität, Cologne). Z. Naturforsch., 18a: 265-75(Mar. 1963). (In German)

The conventional quantum theory gives no real, that is, independent of the observer, natural description. If it is required that it must give an absolute reality of the natural phenomena at least in the macroscopic region, then the quantum theory must be changed. One possibility of that kind is discussed. A model of a quantum theory, which for small systems agrees with the usual theory, but for large systems deviates so much from them that the absolute reality of macroscopic size remains steady, is described. This was achieved by means of an additional term in the motion equation for the density matrix. This additional term plays no role for the small system. For macroscopic systems however it causes an automatic reduction of the density matrix "as if" all macroscopic size of the system was observed perennially. (tr-auth)

22773 RESTRICTIONS ON THE MAGNITUDE OF THE COUPLING CONSTANT IN QUANTUM FIELD THEORY. [PART] I. B. V. Geshkenbein and B. L. Ioffe (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 1211-27(Apr. 1963). (In Russian)

By employing the Lehmann–Källen expansion of the Green function and using the dispersion relation for the vertex part $\Gamma(\kappa^2)$, it is demonstrated that for given masses the coupling constant g^2 should be restricted from above. A concrete expression was derived for the quantity that restricts the coupling constant. Thus, for example, for the deuteron $g^2 < 16\, m_d^2 \sqrt{\Delta/m}$ (m_d and m are the deuteron and nucleon masses, Δ is the binding energy). For π-meson-nucleon interaction $f^2 < 0.47$. (auth)

22774 ANALYTIC EXPRESSIONS FOR THE UPPER LIMITS OF THE COUPLING CONSTANTS IN QUANTUM FIELD THEORY. N. N. Meiman (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR).

Zh. Eksperim. i Teor. Fiz., 44: 1228-38(Apr. 1963). (In Russian)

Analytic expressions for the upper limits of the coupling constants of the three fields a, b, and c are derived as functions of the particle masses m_a, m_b, and m_c. (auth)

22775 REGGE POLES IN QUANTUM FIELD THEORY. Yu. M. Malyuta (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 1317-19 (Apr. 1963). (In Russian)

The unitarity condition and dispersion relations are employed for deriving asymptotic expressions for the meson-meson scattering amplitude in the region of large momentum transfer. (auth)

22776 GAUGE INVARIANCE AND THE MAGNITUDE OF THE RENORMALIZATION CONSTANTS OF QUANTUM ELECTRODYNAMICS. Owen Fleischman. Thesis, New York, New York Univ., 1962. 117p.

Using the Gupta-Bleuler formalism for quantum electrodynamics, it is proven that the regularized second order vertex function, in the limit of high momentum transfer P^2, on the mass shell, is given by $\gamma_\mu C \log P^2$ rather than γ_μ. This proves that the assumption of Gunnar Kallén, that the renormalized vertex function tends to $Z_1\gamma_\mu$ in the above limit, is not valid to second order in the Feynman gage. Since the Kallén formalism is the proper renormalization of the Feynman gage, this indicates that Kallén's assumption is not valid in the Kallen gage. The failure of this assumption would invalidate Kallén's proof that a completely finite theory of quantum electrodynamics cannot be formulated in a consistent way. The gage transformations that produce changes in the propagators, and therefore produce changes in the magnitude of the renormalization constants, were first given by Landau and Khalatnikov. A valid operator gage transformation is formulated that reproduces the Landau transformations for the propagators. This operator gage transformation introduces a set of non-interacting scalar fields in a Hilbert space which has an indefinite metric. (M.P.G.)

22777 PRE-LOCAL SCATTERING THEORY. James Edward Hardy. Thesis, Princeton, N. J., Princeton Univ., 1962. 75p.

It is shown that a set of interacting particles can be described by means of asymptotic limits applied to interacting fields, which are not necessarily locally commutative, without the violation of any of the usual axioms of quantum field theory. This is done by showing that the reduction formulas of Lehmann, Symansik, and Zimmermann can be modified to exclude integration over all regions of configuration space in which field operators do not have time-like separation. The discussion is restricted to scalar neutral particles without bound states, but can be readily generalized. After a review of the axioms of quantum field theory and a summary of the theory of scattering and the properties of the S matrix, examination of the asymptotic condition leads to the modification of the usual reduction formulas. Expressions are then given for general S-matrix elements in terms of nonstandard vacuum expectation values of products of the interacting (not necessarily local) fields. An analysis of the commutation properties of interacting fields consistent with the usual interpretation of the asymptotic fields (namely that they describe almost free particles) shows that the only necessary restrictions occur near the mass shells. Further, the usual assumptions about the possible forms of singularity on the mass shells having been made, necessary and sufficient commutation conditions are given to ensure the standard interpretation of the theory, even for non-local fields. A discussion of the two-point function indicates some of the difficulties inherent in modifying the usual vacuum expectation value formalism, while in a discussion of the vertex function it is shown (independently of perturbation theory) that the generalized reduction formulas are self consistent. (Dissertation Abstr.)

22778 THE TWO-BODY PROBLEM IN GEOMETRODYNAMICS. Richard Wallace Lindquist. Thesis, Princeton, N. J., Princeton Univ., 1962. 177p.

Several possible models of two interacting masses are constructed within the framework of classical geometrodynamics. In keeping with the spirit of geometrodynamics, it is assumed that the space-time continuum is free of all real sources of mass and charge; particles are identified, not with singularities or external sources, but with multiply-connected regions of empty space. Particular attention is focused on an asymptotically flat space containing a "handle" or "wormhole." When the two mouths of the wormhole are well separated, they appear under not too close inspection as two centers of gravitational attraction of equal mass. If, in addition, an electric field is allowed to thread through the wormhole, the two mouths appear as two small regions of space with high field concentration; they can be interpreted as two "particles" with equal but opposite charge. In formulating the two-body problem several simplifying assumptions are made and described. The conformal factors $\omega(x,y,z)$ and $\nu(x,y,z)$ are determined from the time-symmetric initial-value equations for gravitation plus electromagnetism; they contain five arbitrary parameters (three in the case of an initial hypersurface with the wormhole topology), which are determined uniquely when the mass and charge of the two mouths and their initial distance of separation have been specified. These time-symmetric initial-value data are used as the starting point for a numerical solution of the remaining (dynamic) field equations. Methods which might be used to describe the dynamical evolution of the two-body system in invariant terms are discussed briefly. Finally, the problem of a wormhole imbedded in a closed quasi-spherical universe is investigated. A class of solutions to the complete set of (source-free) field equations is found. Each of these solutions, which possess a higher degree of symmetry than the ones obtained for a wormhole imbedded in an asymptotically flat space, develops a real singularity in a finite proper time. It is shown that this singularity can be interpreted as the collapse of the universe to zero volume, but that the form of the singularity is, in some cases, dimensionally different from that encountered in the closed universes of Tolman and Friedmann. (M.P.G.)

22779 NUCLEAR THEORY REFERENCE BOOK FOR 1959 AND 1960. Compilation of Nuclear Theory Index Cards. (National Academy of Sciences and National Research Council). Apr. 1963. 156p. $1.00(GPO).

Approximately 2800 references to articles for 1959 and 1960 on alpha decay, beta decay and parity, electromagnetic radiation, nuclear models, nuclear properties, nuclear reactions, nuclear structure, and special topics are included. (D.C.W.)

22780 NUCLEAR THEORY REFERENCE BOOK FOR 1957 AND 1958. Compilation of Nuclear Theory Index Cards. (National Academy of Sciences and National Research Council). Apr. 1963. 141p. $1.00(GPO).

Approximately 2600 references to articles for 1957 and 1958 on alpha decay, beta decay and parity, electromagnetic radiation, nuclear models, nuclear properties, nuclear reactions, nuclear structure and some special topics are included. (D.C.W.)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 21931, 21973, and 22112.

22781 (ACNP-63002) PRESSURE DROP AND VOID FRACTION EXPERIMENTS IN SIMULATED PATHFINDER BOILER FUEL ELEMENTS. G. Kangas and K. Neusen (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Mar. 8, 1963. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 93p.

A heat-transfer research and development program is being carried out in support of the Pathfinder boiling-water, integral-superheating reactor. Studies were made of the effects of tube-sheet type spacers on the axial pressure profile in a simulated fuel element. The effect of boiling on the frictional and spacer type pressure losses in a 6-ft long test section was measured. The void fraction in a test section was measured by a fine gamma-ray traversing technique. The flow downstream from a spacer quickly became established except near the bundle entrance. The local radial void distribution in boiling flow over a rod array was non-uniform with a uniform radial power distribution and the over-all integrated void fractions tended to support the homogeneous model. (M.C.G.)

22782 (AEET/CD/10) NEUTRON DOSIMETRY OF APSARA BY USING THERMAL AND THRESHOLD REACTIONS. K. S. Venkateswarlu, K. R. Ramaprasad, Ramendra Shanker, Manohar Lal, V. Subramanyam, and M. G. Sane (India. Atomic Energy Establishment, Trombay). 1963. 16p.

Suitability of cobalt, iron wire, and ferrous ammonium sulfate as neutron dosimeters was investigated by using threshold reactions to map the thermal neutron fluxes at several positions and the fast neutron spectrum at the high flux positions in APSARA. Irradiation and separation procedures are discussed; fluxes are displayed; and use of ferrous ammonium sulfate is recommended when possible since it can be used to scan the entire neutron spectrum and since its activity can be analyzed long after irradiation. (D.C.W.)

22783 (ANL-6705) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1963. (Argonne National Lab., Ill.). Apr. 15, 1963. Contract W-31-109-eng-38. 73p.

Progress is reported on BORAX-V, liquid-metal-cooled reactors including EBR-I and -II and FARET, general reactor technology, plutonium recycle program, advanced systems research and development, direct conversion studies, and fast and thermal reactor safety studies. (M.C.G.)

22784 (ARF-3124-1) STABILITY OF UO_2–NaK SLURRIES. Final Report. T. M. Rymarz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 29, 1960. For Argonne National Lab., Ill. Contract AT(11-1)-578. 37p.

The UO_2–NaK system was studied with special reference to the wetting of UO_2 by NaK and the effect of temperature on the viscosity of the UO_2–NaK slurry. It was found that UO_2 powder of approximately 1 micron average particle diameter was wetted by NaK at approximately 400°C. No evidence of dewetting or flocculation was noted at temperatures up to 600°C, although it was not proved conclusively that flocculation does not occur at the higher temperatures. Some evidence of reaction between UO_2 and NaK or impurities in the NaK was found. This was evidenced by a change in the color of the UO_2 after exposure to NaK at 600°C. The UO_3–water system was studied with regard to application to a reactor core consisting of layers of granulated UO_3 cooled by water. Beds of UO_3, covered with water, were heated to 300°F. Resistance to the flow of water was measured. Heating of the beds in contact with water produced a slight change in particle size distribution but the change in flow resistance was negligible. (P.C.H.)

22785 (BAW-TM-344) CARBON STEEL FOR STAINLESS STEEL IN NUCLEAR REACTORS. An Illustration of the Literature Search as a Preliminary Design Tool. J. D. Malley (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Dec. 1960. 28p.

References (422) on the use of carbon steel instead of stainless steel in nuclear reactor systems are given to journals, reports, and bibliographies published from 1951 through 1962. It is believed that a carbon steel reactor system could conceivably be operated at high pH with an oxygen overpressure. (P.C.H.)

22786 (EANDC(E)-44L) COMMENTS ON STUDY OF THE SENSITIVITY OF FAST REACTOR CALCULATIONS TO UNCERTAINTIES IN NUCLEAR DATA. E. Clementel (Italy. Comitato Nazionale per l'Energia Nucleare, Bologna). Jan. 1963. 6p.

Sensitivity of calculations of reactivity, breeding ratio, and internal breeding ratio for fast reactors fueled with Pu^{239}–U^{238} and U^{233}–ThO to uncertainties in microscopic nuclear data was examined. Tables showing sensitivities to various changes, estimated uncertainties in nuclear parameters, and reactivity uncertainties resulting from nuclear parameter uncertainties are given for various reactors. (D.C.W.)

22787 (EUR-134.e) CAROLINE I. A CALCULATION METHOD FOR NONIRRADIATED ORGANIC LIQUID HEAVY WATER LATTICES. G. Casini, W. de Haan, E. Diana, C. Foggi, A. Kind, and G. Rossi (European Atomic Energy Community). 1962. 28p.

The main lines of the nonirradiated lattice calculations in ORGEL-type reactors are presented. This method (called Caroline I) is based on the French correlation for heavy water-moderated and -cooled lattices and takes account of the differences arising out of the presence of organic in the fuel element. The method was compared with the results of critical experiments carried out on natural uranium oxide, heavy water, organic lattices, and a fairly satisfactory agreement was found. The criteria used to determine the effective resonance integral constants of the uranium carbide lattices for which no experimental values are available are illustrated. Caroline I was programmed on IBM 7090. The arrangement of the code input and output data is shown. (auth)

22788 (GEAP-3940) MULTI-ROD BURNOUT AT HIGH PRESSURE. E. E. Polomik and E. P. Quinn (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 1962. Contract AT(04-3)-361. 44p.

Thirty-two burnout points were obtained on an electrically heated assembly of nine simulated fuel rods in a square channel. The hydraulic diameter was 0.52 in., and the 0.375-in.-dia. rods were uniformly heated over an

18-in. length. Test conditions ranged from 0.01 to 0.35 in steam quality at pressures of 1000 and 1400 psia, and mass velocities of 0.56×10^6 and 1.12×10^6 lb/hr-ft^2. Burnout was found to occupy only at locations which faced unheated surfaces. Burnout heat-flux relationship with bulk terminal quality was unaltered by a relative increase of 22% in corner rod heat flux. Burnout limit design curves, which are based on single rod measurements, pass through or are below these multi-rod data. Comparison with similar single rod data indicates a slightly different relation of burnout heat flux with quality and the opposite trend with mass velocity. The data compare favorably with those of other investigators. (auth)

22789 (GEMP-173) NINE AND SIXTEEN GROUP CROSS SECTIONS FOR REACTOR ANALYSIS. C. S. Robertson and E. M. Benson (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Jan. 7, 1963. Contract AT(40-1)-2847. 35p.

Nine and sixteen group cross sections for use in transport theory codes are listed. Elements included are H, Be, B, C, O, Al, Ti, Cr, Mn, Fe, Ni, Co, Y, Zr, Nb, Mo, Eu, Gd, Ta, W, Re, Th, U, and Pu. A discussion of the format and the method used to process these is included. (auth)

22790 (GNEC-275) DEVELOPMENT OF HYDRAULIC BALL (HY-BALL) CONTROL SYSTEM. Quarterly Progress Report No. 3, January–March 1963. (General Nuclear Engineering Corp., Dunedin, Fla.). Mar. 29, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(38-1)-207. 93p. (EURAEC-641)

Physics analyses of power distributions for the Hy-Ball controlled core were continued. Axial power distributions were computed for a two-zone fuel-enrichment scheme and also for a single-zone poison scheme; the computations included all effects with the exception of changes due to fuel burnup and variations in void distribution. Computations for determining radial power distributions begun previously were completed. The pre-test analytical studies of the effects on Hy-Ball column operation due to steam formation within the control system were completed. The pre-test analytical evaluation of methods, such as the use of thermal insulation, for reducing the amount of steam formed within the control system was completed. Detailed parameter studies were conducted on several control valve systems and also on several buffer systems to determine which systems are the most promising. Tests were conducted on the parallel-stepped Hy-Ball control system, using the cold-test loop which operates with water at room temperature. This system will be also tested, using the hot-test loop which operates with water at 572°F; construction of the hot-test loop is about 90% completed. (auth)

22791 (HW-64564) PROJECT CGI-791—REACTOR CONFINEMENT FILTER HANDLING SYSTEMS. E. G. Shockey and C. E. Jones (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 6, 1960. Contract AT(45-1)-1350. 15p.

A study was performed to outline a method for handling contaminated filter frames used in reactor confinement. The frames are contained by plastic or wooden containers during removal. Other information and drawings related to frame transport, filter removal, and filter replacement are included. (J.R.D.)

22792 (HW-67418) REACTOR CONFINEMENT PROJECT CGI-791 OPERATING MANUAL—106-K. D. E. Newby and C. E. Jones (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 30, 1960. Contract [AT(45-1)-1350]. 57p.

An operating manual for equipment for control of the release of radioactive material from the reactor buildings in the event of a reactor incident is presented. The facilities include the fog spray system, filter building and associated ductwork, sample building, and ventilation modifications in the 105 Buildings. Information is given on theory, design, functions of the system components, recommended operating procedures for the equipment, operating precautions, and reference material. (M.C.G.)

22793 (HW-68984) PROJECT CGI-791—REACTOR CONFINEMENT OPERATIONAL ASPECTS. C. E. Jones (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 13, 1961. Contract AT(45-1)-1350. 39p.

Operational aspects of the reactor confinement program are discussed. Necessary background information is presented, together with a description of the system and an explanation of the system components. The proposed filter handling system that is to permit filter replacement by semi-remote methods is explained, and anticipated operating problems are summarized. 48 references. (auth)

22794 (IDO-11003) ORGANIC COOLANT ESSENTIAL DATA. Quarterly Report No. 6, July 1–September 30, 1962. J. A. Ellard, C. D. King, W. H. Hedley, W. J. Moodie, Chia-Wei Woo, and W. H. Yanko (Monsanto Research Corp. Dayton Labs., Ohio). Oct. 9, 1962. Contract AT(10-1)-1088. 57p.

A revised Benedict-Webb-Rubin equation of state for biphenyl was derived and used for calculations of a thermodynamic network and critical constants. The critical constants were in good agreement with measured values, and the revised equation gave the best description obtained so far for the liquid and critical region. The Bunsen-type isothermal drop calorimeter, constructed for biphenyl and organic coolant liquid heat capacity determinations, was modified to give measurements consistent to ±0.2%. Calibration drops were completed on the Pt–20% Rh sample at 100 to 500°C. The biphenyl data will be used to check the thermodynamic network derived from PVT data and will indicate refined measurements required for establishing a set of confident biphenyl thermodynamic properties. Ortho-Terphenyl PVT measurements were initiated to establish its thermodynamic network. Purification methods for the isomeric terphenyls were developed, and samples, with purities exceeding 99.99%, were prepared for thermodynamic and physical property measurements. Biphenyl liquid and vapor viscosity and thermal conductivity values were calculated in 10°F increments from the melting point to at least 850°F. A Fortran program, employing derived equations, was written for IBM-704 calculation of these properties. A Fortran program was also written and tested for computer calculation of liquid thermal conductivity from resistance and current measurements obtained with the center wire conductivity cell. Liquid ortho-terphenyl thermal conductivity measurements over 100 to 200°C obeyed the relation: $k = -0.239 \times 10^{-6}T + 403 \times 10^{-6}$ cal/sec-cm-°K. A 1000-hour run in the test loop, circulating biphenyl vapor at 700°F and velocities of 100 and 1000 ft/sec, was initiated to test the stability of the hot biphenyl vapors to chemical deposition on and corrosion and erosion of selected metals. Successful tests could demonstrate feasibility of biphenyl as a turbine working fluid. The test loop

was modified to improve performance by installation of temperature recorders in the surge tank and condenser, a heater tube bypass line between the flash tank and auxiliary heater, and a flash tank level indicator. The latter was removed and returned to the manufacturer for correction of inadequate seals. Both liquid and vapor Potter flow meters were overhauled and reinstalled. Erroneous readings of the heater tube wall thermocouples prevented accumulation of heat transfer data. Poor wall-to-thermocouple contacts were suspected and correction was unsuccessfully attempted by several rebrazing operations. Adequate methods for brazing wall couples are under development for the new heat transfer tube. Heat flux balances were made and discrepancies were found which may be due to unexpected boiling in the heater tube. (auth)

22795 (IDO-11221) FIRST SEMI-ANNUAL PROGRESS REPORT ON ORGANIC COOLANT TECHNOLOGY DURING MAY THROUGH OCTOBER 1962. J. F. Black, M. E. Conn, and P. R. Geissler (Esso Research and Engineering Co. Products Research Div., Linden, N. J.). Dec. 14, 1962. Contract AT(10-1)-1124. 56p.

The extent to which various constituents of organic reactor moderator-coolants used at equilibrium can contribute to the fouling of fuel element surfaces was studied. The study technique involves labeling all compounds comprising the coolant with either C^{14} or H^3 and measuring the specific C^{14} or H^3 activities of the film deposited on a heater tube as determined in dilution specimens in OMRE coolant. Work on film formation studies was devoted to construction of a capsule fouling test apparatus and preparation of labeled coolants. In decontamination studies, a promising Ni agent was examined for use in removal of S^{35} and P^{32} from organic coolants. Further work is in progress on this and other metals and reduced oxides for removal of these contaminants. (J.R.D.)

22796 (MITNE-25) MEASUREMENTS OF REACTOR PARAMETERS IN SUBCRITICAL AND CRITICAL ASSEMBLIES: A REVIEW. Irving Kaplan (Massachusetts Inst. of Tech., Cambridge). Aug. 15, 1962. Contract AT(30-1)-2344. 61p. (NYO-10207)

The literature on the relations of parameters obtained in various types of assemblies is surveyed. The emphasis is placed on experimental results obtained in thermal systems and on problems raised by the existing data. 135 references. (J.R.D.)

22797 (NMI-7215DE) EVALUATION OF RESTRAINT TUBES 128, 129 AND 136. E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). July 16, 1962. Contract [AT(30-1)-1565]. 31p.

The results of the evaluation of Restraint Tubes 128, 129, and 136 are presented. The tubes represent 2 of a set of 5 tube designs fabricated to test the effect of cladding restraint on fuel swelling during irradiation. The restraint tubes have unalloyed U cores and are similar in geometry to the Zircaloy-clad metal fuel tubes for the HWCTR; the differences are primarily in cladding thickness. Tube 129 was found satisfactory in all respects except for a longitudinal ridge on the outside of the tube; it is considered acceptable for irradiation. Tube 128 is satisfactory in all respects except for a striation in the outside cladding over the front taper section. It is not presently considered for irradiation because of the better quality of Tube 136, which is of the same design. (P.C.H.)

22798 (NYO-10301) A TECHNICAL AND ECONOMIC EVALUATION OF SOLID-FUEL GASIFICATION USING NUCLEAR HEAT. PRODUCTION OF PIPELINE GAS, LIQUID FUELS, AND CHEMICALS FROM LIGNITE AND BITUMINOUS COAL. Period Covered: May to October 1962. L. J. Pieroni, R. P. Griffin, and W. H. Heffner (Kellogg (M. W.) Co., New York). Nov. 30, 1962. Contract AT(30-1)-3009. 200p. (RD-62-952)

Results are reported of a study to determine the most economical method of utilizing nuclear heat to gasify a North Dakota lignite and a West Virginia bituminous coal so that the resulting gas is suitable as a source of synthesis gas for fuels and chemicals. Heat is transferred from a high-temperature, gas-cooled nuclear reactor to the solid-fuel gasification plant by a stream of 435-psig helium heated to a maximum temperature of 2500°F. There is no in-reactor processing involved, hence radioactivity in the processing plant is assumed to be negligible. Design of the nuclear reactor is beyond the scope of this study. It was concluded that the gasification may be carried out more economically in a fluidized bed containing immersed heat-transfer tubes than in either a fixed-bed or an entrained-bed gasifier. If nuclear heat costs no more than 95 cents per million Btu, pipeline gas can be produced at lower cost than by any steam-oxygen gasification process, but still not cheaply enough to compete with natural gas at the present time. Production of gasoline is not economically attractive. (auth)

22799 (TID-18524) ADAPTIVE CONTROL FOR NUCLEAR REACTOR START-UP AND REGULATION. C. N. Shen (Rensselaer Polytechnic Inst., Troy, N. Y.) and F. G. Haag (Knolls Atomic Power Lab., Schenectady, N. Y.). [1961]. Contract [W-31-109-eng-52]. 4p.

Optimization methods were used to synthesize a reactor control system that is input adaptive. The final optimized control system requiring amplifiers with time-varying gains, has several advantages over conventional feedback systems. The optimization procedure defines in precise mathematical terms the purpose of the control system and the usual power overshoot is eliminated. (auth)

22800 (TRG-Report-463) TWO MERCURY PROGRAMS TO ASSIST IN THE CALCULATION OF CHANNEL TO CHANNEL TEMPERATURE VARIATIONS. P. Nichols and J. M. Hughes (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). Jan. 4, 1963. 9p.

A method is described for calculating the probability of a specified number of reactor fuel channels exceeding a given temperature limitation. Two Mercury programs were written to assist in the calculation. (auth)

22801 (CEA-tr-A-1177) RAPPORT SUR UN PROJET DE CALORIMETRE POUR DETERMINER L'ECHAUFFEMENT DES MATIERES DISPOSES DANS LES CANAUX D'IRRADIATION DU FR 2. (Calorimeter Design for Determination of Heating from Objects Placed in Irradiation Channels of the FR-2). Schuelken and Kapulla (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Germany). Translated into French. 1962. 28p.

The design of a calorimeter for the measurement of the heating of materials placed in the FR-2 irradiation channels is described in detail. After a brief review of the need for such a calorimeter, the causes for the heating are summarized. The factors guiding the selection of materials for the calorimeter are described. The contribution of neutron and γ-ray absorption to the heating is calculated, and the principles of the calorimeter chosen are given. Construction of the calorimeter and temperature measurement are then described. The heat losses are calculated, and the methods used for calibration are given. An estima-

tion is made of the measurement limits of the device. (J.S.R.)

22802 (EURAEC-508) DESCRIPTION OF THE CISE CIRCUIT FOR CAN-3 EXPERIMENTS IN REACTOR. Special Report No. 13. (Centro Informazioni Studi Esperienze, Milan). Nov. 1962. Work Performed under United States–Euratom Joint Research and Development Program. 38p. A translation.

The design and operation of the CISE in-pile loop are described. The loop is intended for use in studies of corrosion, radiolytic decomposition, and coolant contamination deposition and composition. (J.R.D.)

22803 (EURAEC-567) IMPROVEMENT OF HEAT TRANSFER IN NUCLEAR REACTORS WITH BOILING WATER. Quarterly Report No. 11. (Société Nationale d'Etude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). Dec. 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 058-61-7-RDF. 17p. A translation.

Results of a neutronic study led to a definition of the additional enrichment which is necessary to compensate for the effect produced by the introduction of spinners in the SENN reactor fuel elements. With Zr spinners, 0.6 mm thick, enrichment must be increased from 2.1 to 2.15%, but stainless steel spinners lead to an enrichment up to 2.75%. The gammametry apparatus (1-c CS^{137} source) was used to measure the vacuum fraction in a canal containing four rods through which a mixture of water and air was flowing. The test section was equipped with spinners for some experiments, while in others no spinners were used. The results are compared with the vacuum fraction obtained by electrolytic methods. It was found that maximum differences between the two methods are from –12 to +14% (average difference –1%) with more dispersion for the gammametry method. Thermal tests on the canal with four heating rods, without spinner, show distinct types of crises which are localized either at the entry or at the outlet of the test section. It appears that under certain conditions, "slow crises" appear at the outlet of the test section towards the inside of rods, while "fast crises" are observed at the entry of the test section toward the outside of rods. After the study of head losses in a circular test section without spinners, on the high-pressure loop, the test section was destroyed by an explosion while trying to establish a critical flux. (auth)

22804 (EURAEC-580) STUDY ON THE VIBRATIONS AND LOAD LOSSES IN TUBULAR CLUSTERS. Final Report No. 1. November 1, 1960 to December 31, 1961 and January 1, 1962 to December 31, 1962. (Société Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). Jan. 1963. Work Performed Under United States–Euratom Joint Research and Development Program. Contracts 025-60-10-RDF and 083-62-1-RDF. 78p. A translation.

Activities in a program to examine the vibrations in Euratom fuel clusters immersed in flow parallel to their axes are reported. Such clusters are composed of seven tubular fuel units, a central unit and six peripheral fuel elements. A review of previous research results is included. Information is also included on experimental techniques, calculations of natural frequency and amplitude, and flow tests with horizontal and vertical models. (J.R.D.)

22805 RESONANCE INTEGRAL AND THE PROBABILITY OF COLLISION APPLIED TO THE CALCULATION OF THE DANCOFF COEFFICIENT. G. Velarde (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 239-54(Sept.-Oct. 1962). (In Spanish)

The Dancoff coefficient in the resonance integral was calculated for the case of concentric-ring fuel elements. (auth)

22806 THE DYNAMICS OF THE SPHERICALLY SYMMETRICAL FAST PULSED REACTOR. V. F. Kolesov. At. Energ. (USSR), 14: 273-80(Mar. 1963). (In Russian)

The self-regulation of fast, pulsed reactors is due to the thermal expansion of the core; for this reason the dependence of the core on the power level and the correlation of the multiplication factor with the shift of the core must be closely studied. The hydrodynamic model, used to describe emergency processes in the Godiva-type reactors, approximates the true conditions only roughly because the fuel never becomes liquid. Therefore, a model was developed for considering the core as an ideally elastic medium and determining the relation between the reactivity and the shift of the medium by means of perturbation theory. The equations obtained give a better representation of the true conditions and include both the fast processes including the case when the thermal expansion lags behind the temperature rise and the slow ones leading to the extinction of the reactivity. The equations were solved for both a continuous-core reactor and one with the core divided in 4 spherically symmetrical regions. It was found that in the latter case the upper limit of heat generation per pulse depends on the stresses induced in the core material. The stresses are due to the uneven temperature distribution caused by dynamic effects. Separation of the core into 4 regions was found to minimize these stresses. (TTT)

22807 DETERMINATION OF THE EXTERNAL BLOCKING EFFECT IN MULTIPLYING SYSTEMS WITH HEAVY WATER AS MODERATOR. V. F. Belkin, O. V. Shvedov, and B. P. Kochurov. At. Energy. (USSR), 14: 281-4(Mar. 1963). (In Russian)

The external blocking effect which determines the thermal utilization coefficient plays an important role in heterogeneous reactor calculations; therefore, tests were carried out to determine the value of this effect in a D_2O-moderated reactor with rod-shaped, natural-uranium fuel elements. The blocking effect was derived from neutron density measurements, using disks containing about 3 mg/cm^2 Dy for detecting the thermal and about 25 mg/cm^2 In for detecting the epithermal neutrons. The relative activity of the detectors was obtained by using the method of Yu. G. Abov et al. (Atomnaya Energ. 12, 156 (1962) No. 2). Comparison of the experimental data with the theoretical values showed good agreement. A marked blocking effect was noted for epithermal neutrons. (TTT)

22808 PREPARATION OF SINTERABLE UO_2 POWDER. L. Halle and S. Brandberg (ASEA, Atomkraftabteilung, Västerås, Sweden). Atomwirtschaft, 8: 101-4(Feb. 1963). (In German)

The sintering properties of some commercial UO_2 powders prepared by various methods are compared. The effect of the process variables in the preparation of the powder on the properties of the finished fuel element is discussed. A method was described by which UO_2 powder with high sinter activity was prepared by boiling a complexing solution of uranium with ammonium carbonate. The different phases of preparation were illustrated using experience gained with a small production installation. A

granulation process and construction of an oven were described. (tr-auth)

22809 A LARGE PRESSURIZED D_2O REACTOR WITH UNIFORM FUEL ELEMENT DISTRIBUTION. A. Jonsson (Johnson-Konzerns, Stockholm). Atomwirtschaft, 8: 105-8 (Feb. 1963). (In German)

A design for a large pressurized D_2O reactor is based on two fundamental approaches—the use of a uniform wide lattice core and the use of components already developed for pressurized H_2O reactors. The core design is characterized by the fact that the uniformly spaced fuel lattice prevents local perturbations in flow distribution and the widely spaced lattice permits large dimensional tolerances, easy insertion or removal of fuel elements and control equipment, and low pumping power. Other advantages are the stability, low peak-to-average conditions, and increase of flow through the hot channel. (J.S.R.)

22810 REACTOR AND FUEL MATERIAL IN NORWAY. S. Aas (Institutt for Atomenergi (IFA), Kjeller, Norway). Atomwirtschaft, 8: 113-16(Feb. 1963). (In German)

The design, construction, and operation of two research reactors and one power reactor in Norway have given the Institutt for Atomenergi and Norwegian industry an excellent background for understanding and handling many of the materials problems such reactors present. As Norway is a major producer of Al, the use of this metal in reactor construction has presented no problems of procurement or processing. Manufacture of stainless steel components for the Halden Reactor showed the competence of the Norwegian industry. Fuel element studies have concentrated on the use of UO_2 fuel. Comparisons were made of the utility of Al, Zircaloy-2, and stainless steel as canning materials. (J.S.R.)

22811 NORWEGIAN INDUSTRY AND ATOMIC ENERGY. Fredrik Moeller (NORATOM A/S, Oslo). Atomwirtschaft, 8: 119-20(Feb. 1963). (In German)

The construction of the heavy water cooled and moderated reactors in Norway—JEEP, Halden boiling water reactor, NORA reactor, and JEEP-II (now under construction)—was accomplished chiefly by Norwegian firms as subcontractors. Imports were limited to fuel, graphite, and special equipment. The formation of NORATOM for the commercial exploitation of nuclear power was described. The firm designs nuclear instruments and installations and subcontracts their manufacture. (J.S.R.)

22812 INSTITUTT FOR ATOMENERGI—THE ATOMIC ENERGY RESEARCH CENTER IN NORWAY. Tor Volledal (Institutt for Atomenergi (IFA), Kjeller, Norway). Atomwirtschaft, 8: 121-2(Feb. 1963). (In German)

The Institutt for Atomenergi was founded in 1948 and its first activity was the construction of JEEP, the first reactor outside the great atomic powers. Since that time, the projects undertaken include the Halden Boiling Water Reactor, NORA Zero Power Reactor, and JEEP-II. The spectral shift control system is one of the principal studies at the NORA Reactor. At Kjeller, studies of the various steps in the fuel cycle are being made. Radioisotopes are also produced there. (J.S.R.)

22813 ON THE REACTOR TRANSIENT STATES IN REACTOR REFUELING WITH CONSTANT RATE OF SPEED. Václav Bartošek (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Rez). Jaderna Energie, 9: 74-7(1963). (In Czech)

The dependences of the total time interval of reactor transient state, the radiation stability of fuel elements, the burn-up of fuel, and the necessary speed of fuel element exchange are investigated for two types of transient with constant rate of exchange speed: for equilibrium transient and transient with delay. Some numeric evaluations for natural uranium reactors are reported. (auth)

22814 APPLICATION OF THE SLOWING DOWN THEORY TO THE INVESTIGATION OF PROBLEMS OF FUEL ELEMENT BURN-UP IN REACTORS. K. Meyer (VEB RPkA, Berlin). Kernenergie, 6: 12-20(Jan. 1963). (In German)

A method for the investigation of the effect of the mode of operation on the fuel burn-up in a reactor was described. This method leads to an integral equation, which was solved for a special transformation model by means of the Greuling-Goertzel method known from the theory of neutron slowing down. The method is applied as illustration to two different modes of operation. The results obtained were compared with each other and discussed. The difference in the initial enrichment of the fuel material or in the fuel material costs for both modes of operation was determined. (tr-auth)

22815 THEORETICAL PROBLEMS IN CONNECTION WITH WATER-GAP PEAKING IN PRESSURIZED WATER REACTORS. A. Mueller (VEB EpkA, Berlin). Kernenergie, 6: 20-8(Jan. 1963). (In German)

Problems on the calculation of water-gap peaking in pressurized water reactors were discussed using examples from the literature and some investigations as a basis. After a brief description of the neutron physics situation, conventional and improved calculation methods were described and comparisons with experiments were carried out. It is shown that approximations of measurement values made at great effort often contain great deviations. Additional systematic experimental and theoretical studies are necessary to remove this unsatisfactory state. Possibilities for decreasing the power peaking were discussed. (tr-auth)

22816 CALCULATION OF THE EFFICIENCY OF A PARTIALLY INSERTED ECCENTRIC CONTROL ROD IN A CYLINDRICAL REACTOR. J. Čermák (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Kernenergie, 6: 28-30(Jan. 1963). (In German)

In an earlier work (At. Ener. (USSR), 9: 470(1960)) a method was given for the calculation of the efficiency of a partially inserted cylindrical absorber rod in the center of the reactor. This method also permits a relatively simple estimation of the variation of the neutron flux density in the vicinity of the rod. The method is extended to a rod in an eccentric position. (tr-auth)

22817 SWAGING OF UO_2 AS A METHOD FOR THE PREPARATION OF FUEL ELEMENTS. Ch. Schurig, H. Spindler, and H. Steinkopff (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 31-7(Jan. 1963). (In German)

After a brief review of the assumptions of swaging, the most important conditions of a technology depending on this method were reported. It is shown that the UO_2 powder from normal production methods is not usable for swaging, but presintering removes this obstacle. Densities of 92% with a very good grain size distribution were obtainable and can be increased to 94% with some effort—thermal working; whereby the transformation takes place in the optimal range from 45 to 55%. Additional density increases can be attained by using thin-walled tubes with the same UO_2 powder. (tr-auth)

22818 MANIPULATED VARIABLES OF REACTOR CONTROL. SURVEY OF THE METHODS AFFECTING RE-

ACTIVITY. B. Schallopp. Kerntechnik, 5: 76-9(Feb. 1963). (In German)

After explaining the different causes, which require the affection of neutron economy in reactors, the basic possibilities are classified. Realizations are internal feedback loops, absorber devices with intrinsic action ("reactor fuse" and "burnable poison"), and externally controlled means. On account of the abundance of examples, only principles are explained; many references, however, indicate more detailed descriptions. (auth)

22819 BREEDER AND CONVERTER. K. Diebner. Kerntechnik, 5: 124-5(Mar. 1963). (In German)

Breeder and converter reactors are discussed. A reactor is called a converter if it consumes more fissionable material than it produces. In a breeder reactor more fissionable material is formed than consumed. The development of breeders is discussed. (M.C.G.)

22820 NEUTRON THERMALIZATION IN A REACTOR LATTICE. R. Bonalumi (CISE, Milan). Nucl. Energy, 96-100(Apr. 1963).

A treatment is presented of the problem of calculation of thermal neutron spectra in a heterogeneous medium with more than one moderating region. Eigenvalue problems are avoided by using a first collision probability method. (D.L.C.)

22821 MINIMUM FUEL LOADING IN NUCLEAR REACTORS. J. Lewins. Nucl. Energy, 103-9(Apr. 1963).

A review is presented of a number of results in Goertzel's problem of minimizing the fuel loading of a nuclear reactor or the similar problem of minimizing the cost of fuel enrichment in a reactor. A consistent development in the two-group diffusion approximation is given and certain previous restrictions are eased without reference to integral theory. A discussion of the existence of a maximum as well as a minimum fuel loading and its significance in graphite power reactors is included. (auth)

22822 NEUTRON THERMALIZATION IN A REACTOR LATTICE. R. Bonalumi (CISE, Milan). Nucl. Energy, 128-33(May 1963).

An analytical solution of the fuel equation is derived, and it is shown that the moderator spectrum can be approximated by a Maxwellian hardened to a proper "neutron temperature". The calculation of neutron temperature and thermal utilization is discussed. Calculated neutron temperatures ("activation" and "kinetic") in fuel elements are compared with experimental values for a CANDU UO_2 clustered lattice, and the agreement is found to be good. A summary of practical formulas is given. (D.L.C.)

22823 DETERMINATION OF THE REACTIVITY OF SLOPING CONTROL RODS. E. R. Schwarz (Siemens-Schuckertwerke, Erlangen, Ger.). Nukleonik, 5: 16-18 (Jan. 1963). (In German)

The analogy existing between the one-group diffusion theory and the cooling of a solid body was used for the determination of the reactivity of sloping control rods in a homogeneous unreflected reactor model. The suitability of various materials for the preparation of the model was discussed, and the reactivities of 23 different arrangements of sloping control rods—with respect to the reactivity of the axial control rod—and the shielding factors for these arrangements were given. (tr-auth)

22824 THE CALCULATION OF THE THERMAL UTILIZATION FACTOR OF A CYLINDRICAL CELL OF SEVERAL CONCENTRIC ZONES. A. Mueller and E. Linnartz (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 5: 23-7(Jan. 1963). (In German)

The Amouyal and Benoist method for the calculation of the f factor of the thermal utilization of a cylindrical reactor cell was generalized from 2 to n zones. The results for a three-zone cell were compared with those of a P_1 and P_3 calculation. The escape probabilities for hollow cylinders were given in the appendix in the form of tables and approximation polynomials. (tr-auth)

22825 DETERMINATION OF THE EXTRAPOLATION LENGTH OF FAST REACTORS IN THE MULTI-GROUP P_1 APPROXIMATION. Horst Borgwaldt (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 5: 27-31(Jan. 1963). (In German)

The extrapolation length necessary for the calculation of the critical dimensions of the core of a fast reactor was investigated on the assumption that in the interior of the one-dimensional homogeneous core the consistent equations of the P_1 approximation apply and a mixed boundary condition exists at the limit. The critical sizes of the core were determined approximately from the series development of this boundary condition by a perturbation parameter. The first series term yields a generalization of the extrapolation length approximation to the mean given by Inönü. Only the persistent spectra of the flux and single-flux function need be known. The recursive determination of the higher series terms necessitates the resolution of a boundary value problem for each term. (tr-auth)

22826 SOME EFFECTS OF Pu-240, Pu-241, AND Pu-242 ON THE Pu-239 CRITICAL MASS OF A FAST REACTOR. Frank Peter Mertes, Jr. Thesis, Ames, Iowa, Iowa State Univ. of Science and Tech., 1962. 55p.

The effects of variation in the isotopic composition of Pu used as a fast reactor fuel material are considered. When the Pu fuel material is produced in a thermal reactor, the primary factor affecting composition is the flux time of irradiation θ, 10^{21} cm^{-2}. Flux times of $\theta = 1$, $\theta = 5$, and $\theta = 10$ were studied. It was found that for a flux time of $\theta = 10$, the concentration of Pu-239 which yielded a critical mass was reduced to a concentration of 7.42% of the fuel from a concentration of 14.1% for the pure Pu-239 case. In all cases studied the spherical core consisted of 35% fuel, 15% Fe, and 50% Na by volume and had a radius of 31 centimeters. The core was surrounded by a blanket of 70% U, 10% Fe, and 20% Na by volume which extended to a radius of 75 centimeters. The critical masses of the fast reactor were calculated by a one-dimensional, two-region, 16-neutron-energy-group computer code written in IBM FORTRANSIT. This code also was used to tabulate the neutron flux in 16 energy groups at each of 75 radius points. No significant change in the flux spectra resulted from the changes in Pu isotopic composition. The peak flux was in the energy range 0.3 Mev < E < 0.5 Mev. The program is compatible with the FORTRAN coding system and could be used to compute the critical mass of any spherical fast reactor with one or two regions. The choice of fuel, coolant, and structural materials in the reactor is in no way restricted by the program instructions. For the particular reactor studied, a one-neutron-energy-group diffusion theory calculation predicted approximately the same changes in critical mass as were obtained from the computer solution. The Pu fuel was assumed to be produced in a thermal Pu recycle reactor with an average enrichment of 1%. The set of differential equations detailing the buildup of Pu-239, Pu-240, Pu-241, and Pu-242 in the

thermal reactor was solved by use of an electronic analog computer. (Dissertation Abstr.)

22827 AN ANALYSIS OF NUCLEAR REACTOR FLUCTUATIONS BY METHODS OF STOCHASTIC PROCESSES. Philip Richard Pluta. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1962. 167p.

The instantaneous neutron density fluctuations in a steady-state subcritical reactor were investigated. A theoretical description of the fluctuations, which could be related directly to an experiment was developed. Experimental validation of the theoretical model is described. An external reactivity perturbation was determined, experimentally, to have no effect on the measured fluctuation data. The dependence of the fluctuations on the relative position of the neutron detector to the maximum neutron density in the reactor was studied experimentally. No appreciable effect was observed. (M.P.G.)

22828 THE THERMAL-DIFFUSION AREA OF A LATTICE-TYPE THERMAL-NEUTRON REACTOR. John Donald Stewart. Thesis, Ithaca, N. Y., Cornell Univ., 1962. 170p.

A general discussion of neutron migration in a lattice is presented. The writer's fundamental definition of L^2 is $L^2 \equiv M^2 - L_s^2$, where M^2 is the migration area, whose definition is as straightforward for a lattice as for a homogeneous medium, and L_s^2 is the slowing-down area or age calculated in the usual way. A working definition of L^2 is introduced by approximating the slowing-down distribution by a step function. Other definitions of L^2 are discussed. It is shown that the working definition leads to the familiar $L^2 = \sum_i f_i L_i^2$ under certain circumstances. To calculate L^2 in the general case, one must calculate what fraction of the thermal neutrons born in one cell will escape into the outside lattice, and the lattice relaxation length of those that do escape. These two quantities are calculated approximately by matching fluxes and currents at cell interfaces. The accuracy is increased by a comparison with a homogeneous medium of the same relaxation length. The method is tested by the microscopic-discrete method. A method for treating the problem of the combination of lattice core and homogeneous reflector is outlined. (M.P.G.)

22829 SPERT TYPE-C STAINLESS STEEL FUEL ASSEMBLIES (Engineering Materials). (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). 13 units. (CAPE-903)

The fuel assemblies are fabricated of fuel-bearing plates, consisting of highly enriched UO_2 particles uniformly dispersed in a matrix of sintered stainless steel powder, with stainless steel cladding that is metallurgically bonded to the core. Individual plates are brazed into the side and center plate to form the assembly with uniform water channels between the plates. The type C No. 1-S assembly consists of 38 fuel-bearing plates, 2 non-fuel-bearing side plates, and one non-fuel-bearing center plate. The type C No. 2-S assembly contains 32 plates. A control-rod type C No. 1-S consists of 32 fuel-bearing plates, two non-fuel-bearing plates, one non-fuel-bearing center plate, and 16 B^{10} stainless steel poison plates. The B^{10} stainless steel poison plates are brazed to the center and the two side plates (see also CAPES 216 and 903). (F.L.S.)

22830 SPERT-II REACTOR CORE AND FUEL ASSEMBLY (Engineering Materials). (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). 13 units. (CAPE-907)

The Special Power Excursion Reactor Test (SPERT-II) is used to provide basic experimental information on reactor kinetic behavior and safety. The flexible facility is used for reactor transient and oscillator studies, and operates to 300 psig and 400°F. Coolant flow is both upward and downward through the reactor core at velocities of 25 ft/sec. No provision is made for heat removal. A light or heavy water coolant is used and the type coolant not being used is isolated from the system. There are two coolant pumps. The stainless steel clad, carbon steel reactor vessel is 10 ft ID and is 16 ft high. The vessel is designed to facilitate changes of core and reflector types. There are two control rods containing fuel in the lower section and cadmium poison sandwich in the upper section. The fuel rods are driven by a single drive mechanism. (F.L.S.)

22831 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. William Edward Lewis (to English Electric Co. Ltd.). British Patent 924,140. Apr. 24, 1963. Filed Oct. 21, 1958.

A fuel element can is provided with fins for improving heat transfer from the can to coolant. The fins include 4 longitudinal guide vanes, 12 longitudinal cooling fins, and mixer vanes disposed at intervals along the length of the can. The mixer vanes are inclined to the coolant stream and are arranged to leave gaps between their trailing edges and the can. (D.L.C.)

22832 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 924,211. Apr. 24, 1963. Priority date Aug. 12, 1958, Germany.

An apparatus is designed for equalizing the pressures in separate coolant and moderator circuits in a heterogeneous reactor, without admixture of coolant and liquid moderator. The apparatus comprises an arrangement of pipes and vessels defining a number of zones which contain a buffer liquid and a protective gas. The buffer liquid is in contact with coolant in one zone and with protective gas in a second zone, and the protective gas is also in contact with liquid moderator in a third zone. (D.L.C.)

22833 IMPROVEMENTS RELATING TO SUPPORTS FOR LARGE STRUCTURES. George William Laing and Alan Roy Pickering (to General Electric Co. Ltd.). British Patent 924,262. Apr. 24, 1963. Filed May 22, 1959.

A skirt support for a structure of curved section, e.g., a reactor pressure vessel, is designed in which the stresses due to thermal gradients in the support are reduced by heating means. The heating means may be an electric heater, bridge pieces between vessel and skirt for creating pockets, heat transfer surfaces, or conductive plates connected between vessel and skirt. Three embodiments of the support are described. (D.L.C.)

22834 DEVICE FOR MONITORING THE PRESSURE TUBE OF A NUCLEAR REACTOR WHICH IS COOLED AND/OR MODERATED BY FLUID MEDIA. Horst Michael (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,144,413. Feb. 28, 1963. Filed Sept. 28, 1960.

A pressure tube is described which consists of two tubes being disposed concentrically to each other and a ring-shaped space between these two tubes which is filled up with an insulating compound, e.g., a ceramic material. Within the insulating compound there is an elongated hollow cylinder of an electrically conducting sheath which subdivides the ring-shaped space in two layers. For monitoring the pressure tube, the hollow cylinder is connected electrically via an ohmmeter with the outer tube. In the event of a

failure of the tubes the electrical resistance of the insulating compound is greatly reduced by the infiltrating fluid medium so that its reduction can easily be detected. (Gmelin Inst.)

22835 METHOD FOR CONTROLLING AUTOMATICALLY THE PERIOD OF NUCLEAR REACTORS. P, Kovanic and M. Kulka (to Zavody V. L. Lenina Plzen). German Patent DAS 1,145,723. Mar. 21, 1963. Priority date, Feb. 18, 1958, Czechoslovakia.

The method described is for controlling automatically the period of nuclear reactors employing a movable nuclear radiation detector. The method comprises the steps of moving the radiation detector with a predetermined velocity along a path, along which the radiation intensity depends exponentially on the space coordinates, and of subtracting the detector signal from an eventually variable reference signal, the resulting difference signal being fed into the driving unit of the control element. (Gmelin Inst.)

22836 METHOD OF FABRICATING A GRAPHITE MODERATED REACTOR. Howard R. Kratz (to U. S. Atomic Energy Commission). U. S. Patent 3,088,890. May 7, 1963.

A nuclear reactor formed of spaced bodies of uranium and graphite blocks is improved by diffusing helium through the graphite blocks in order to replace the air in the pores of the graphite with helium. The helium-impregnated graphite conducts heat better, and absorbs neutrons less, than the original air-impregnated graphite. (AEC)

22837 FUEL ELEMENTS FOR NEUTRONIC REACTORS. Frank G. Foote and Eric R. Jette (to U. S. Atomic Energy Commission). U. S. Patent 3,088,891. May 7, 1963.

A fuel element for a nuclear reactor is described that consists of a jacket containing a unitary core of fissionable material and a filling of a metal of the group consisting of sodium and sodium–potassium alloys. (AEC)

22838 DISPERSION ELEMENT CONSISTING OF CHROMIUM COATED UO_2 PARTICLES UNIFORMLY DISTRIBUTED IN A ZIRCALOY MATRIX. F. M. Cain, Jr. and J. E. Eck (to U. S. Atomic Energy Commission). U. S. Patent 3,088,892. May 7, 1963.

A nuclear fuel element consisting of metal coated UO_2 particles dispersed in a matrix of Zircalloy and having a cladding of Zircalloy is presented. (AEC)

22839 BOILING SLURRY REACTOR AND METHOD OF CONTROL. Michael Petrick and John F. Marchaterre (to U. S. Atomic Energy Commission). U. S. Patent 3,088,895. May 7, 1963.

The control of a boiling slurry nuclear reactor is described. The reactor consists of a vertical tube having an enlarged portion, a steam drum at the top of the vertical tube, and at least one downcomer connecting the steam drum and the bottom of the vertical tube, the reactor being filled with a slurry of fissionable material in water of such concentration that the enlarged portion of the vertical tube contains a critical mass. The slurry boils in the vertical tube and circulates upwardly therein and downwardly in the downcomer. To control the reactor by controlling the circulation of the slurry, a gas is introduced into the downcomer. (AEC)

22840 NUCLEAR REACTOR. Roy G. Post (to U. S. Atomic Energy Commission). U. S. Patent 3,088,904. May 7, 1963.

A nuclear reactor is described that includes spaced vertical fuel elements centrally disposed in a pressure vessel, a mass of graphite particles in the pressure vessel, means for fluidizing the graphite particles, and coolant tubes in the pressure vessel laterally spaced from the fuel elements. (AEC)

22841 METHOD OF MAKING A COMPARTMENTED FUEL ELEMENT FOR A NUCLEAR REACTOR. Robert K. McGeary and Erling Frisch (to U. S. Atomic Energy Commission). U. S. Patent 3,089,830. May 14, 1963.

A method of making a compartmented fuel element is presented. Fuel pellets and spacing disks are inserted into a cladding tube; plugs are inserted at each end and the tube is then stretched lengthwise so that its walls grip the edges of the spacing disks, thereby forming compartments. (AEC)

22842 SAFETY SYSTEM FOR CONTROL ROD. John Arthur Paget (to U. S. Atomic Energy Commission). U. S. Patent 3,089,838. May 14, 1963.

A structure for monitoring the structural continuity of a control rod for a neutron reactor is presented. An electric conductor readily breakable under mechanical stress is fastened along the length of the control rod at a plurality of positions and forms a closed circuit with remote electrical components responsive to an open circuit. A portion of the conductor between the control rod and said components is helically wound to allow free and normally unrestricted movement of the segment of conductor secured to the control rod relative to the remote components. Any break in the circuit is indicative of control rod breakage. (AEC)

22843 CONTROL ROD DRIVE MECHANISM FOR A NUCLEAR REACTOR. Baskc C. Hawke, Fred J. Liederbach, and Walter Lones (to U. S. Atomic Energy Commission). U. S. Patent 3,089,839. May 14, 1963.

A lead-screw-type control rod drive featuring an electric motor and a fluid motor arranged to provide a selectably alternative driving means is described. The electric motor serves to drive the control rod slowly during normal operation, while the fluid motor, assisted by an automatic declutching of the electric motor, affords high-speed rod insertion during a scram. (AEC)

Power Reactors

22844 (ACNP-61528) CHARGE AND SERVICE MACHINE MALFUNCTIONS. HAZARDS ANALYSIS. Alexander W. Dromerick (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Dec. 4, 1961. Contract [AT(10-1)-925]. 34p. (EGCR-STUDY-IV-300 (Rev.3))

The charge and service machines are designed for servicing reactor components and for fuel programming of the Experimental Gas Cooled Reactor while the reactor is operating at power. The results of possible charge machine and service machine malfunctions and the effects of these malfunctions upon reactor operation and the safety of operating personnel are presented. Hazards associated with the future operation of experimental loops are not considered. (auth)

22845 (ACNP-62004) PATHFINDER ATOMIC POWER PLANT. BUTTERFLY VALVE CAVITATION TEST. N. P. Grimm (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Mar. 20, 1963. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 67p.

Tests were made on butterfly valves similar to those used in the discharge leg of each of the three external recirculation loops of the Pathfinder reactor in order to determine the critical values of a dimensionless cavitation

number (Σ), used to specify the limits of operation for reactor valves, at incipient cavitation. The experimentally determined values of the cavitation number were used to determine the cavitation-free control range of the Pathfinder valves. The tests showed that both the undissolved and dissolved air content of the water caused cavitation to occur at higher values of sigma. It appeared that cavitation first occurred in the vortices downstream of the valve disk. A limiting cavitation condition was defined for the reactor butterfly valves. (M.C.G.)

22846 (ACNP-62035) PATHFINDER ATOMIC POWER PLANT. Technical Progress Report, October 1962–December 1962. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Mar. 15, 1963. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 37p.

Design data are presented. Progress is reported on fuel-element research and development and nuclear analysis. Radiation effects on fuel claddings and thermal properties of superheater fuel elements were studied. Dynamic analyses were made of the reactor systems. (M.C.G.)

22847 (ACNP-62606) DETAILED ANALYSIS [OF] LOSS-OF-POWER ACCIDENT. HAZARDS ANALYSIS. D. A. Lampe (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Mar. 20, 1961. Contract [AT (10-1)-925]. 36p. (EGCR-STUDY-IV-311-1(Rev.1))

The EGCR core coolant flow requirements following a loss-of-power accident were evaluated, and the conclusions reached in the preliminary analyses performed and reported in study IV-311 were examined. This evaluation is based upon analogue computer studies using the method outlined in an appendix to study IV-311. (auth)

22848 (ACNP-62608) SAFETY AND CONTROL SYSTEM REACTIONS TO TEMPERATURE BARRIER FAILURE. Ralph P. Marcotte (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). July 5, 1961. Contract [AT (10-1)-925]. 25p. (EGCR-STUDY-IV-315 (Rev.1))

Reactor coolant outlet temperature, reactor power level, and the action of the reactor safety system, following a rupture of the temperature barrier, or temperature barrier-to-core-bottom-plate-seal are determined. (auth)

22849 (ACNP-63506) LOSS-OF-PRESSURE ACCIDENT. COLD LEG PIPING FAILURE. J. Landoni (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Apr. 1960. Contract [AT(10-1)-925]. 26p. (EGCR-STUDY-IV-303-3(Rev.1))

The differential pressure across the reactor core and the steam generator and blower in the sound loop in the event of a circumferential piping rupture at the cold leg isolation valve followed by complete displacement of the severed pipe ends is determined. The effect of quick-opening valves in the coolant loop bypass lines upon the pressure differentials is also investigated. (auth)

22850 (ACNP-63507) LOSS-OF-PRESSURE ACCIDENT—HOT LEG PIPING FAILURE—QUICK-OPENING VALVES IN REACTOR BYPASS LINES. Julio A. Landoni (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). June 17, 1960. Revised Dec. 20, 1962. Contract AT(10-1)-925. 33p. (EGCR-STUDY IV-303-2 (Rev.1))

Activities in a study to determine the differential pressure across the EGCR core following a pipe rupture in the hot leg of the coolant system are reported. Effects of quick-opening valves in bypass lines around the reactor are evaluated, and recommendations concerning these valves and other components are included. (J.R.D.)

22851 (DP-835) HEAVY WATER MODERATED POWER REACTORS. Progress Report, February 1963. L. Isakoff, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Mar. 1963. Contract AT(07-2)-1. 25p.

The Heavy Water Components Test Reactor (HWCTR) was operated at a power level of 37 Mw for more than 90% of the month. Nine assemblies of mechanically compacted UO_2 and one assembly of CANDU prototype UO_2 rod bundles are under test irradiation. The current maximum exposure in a single assembly is 4700 Mwd/ton U. Failure of a second tubular uranium metal assembly occurred in an out-of-pile flow loop because of vibration wear of a spacer through the cladding. Bucklings and the effects of voids were measured in D_2O-moderated lattices of clusters of oxide rods that were "cooled" with various hydrogenous materials. Techniques for fabricating driver rods and Cd–In–Ag-alloy control rods were also developed. (auth)

22852 (GA-2696) FINAL METALLURGICAL REPORT ON 1300°F MGCR GAS TURBINE, APRIL 1, 1961. (Westinghouse Electric Corp. Steam Div., Lester, Penna.). For General Atomic Div. General Dynamics Corp., San Diego, Calif. Contract AT(04-3)-187; Subcontract 187-C-102. 95p.

Several elevated-temperature alloys were evaluated by stress-rupture and fatigue tests in various environments for use in a 1300°F, closed cycle, nuclear-powered gas turbine. Most tests were made in He, the gas chosen for use in the cycle. A few cursory tests were made in air, CO_2, and He mixtures containing small amounts of air, and CO plus CO_2. The following alloys were evaluated in stress-rupture: Discaloy, W-545, and D-979 at 1200°F; Inconel X and Inco 713C at 1300°F; and Inco 700 at 1500°F. Test conditions in the fatigue evaluation were: Discaloy at 1200°F; W-545 at 1100 and 1200°F; D-979 at 1100 and 1200°F; Inconel X at 1300°F; Inco 713C at 1100, 1300 and 1500°F; and Inco 700 at 1500°F. The test program constitutes part of the gas turbine design development for the Maritime Gas-Cooled Reactor Project. (auth)

22853 (GA-3676) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending September 30, 1962. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-314. 53p.

Research and development specifically directed toward the construction of a 40-Mw(e) prototype power plant employing a high-temperature, gas-cooled, graphite-moderated reactor (HTGR) are reported. Operation of the in-pile loop was not possible during most of the quarter because the test reactor did not run. Two short periods of operation, one at the beginning and one at the end of the quarter, resulted in the generation of 41 Mw-hr of fission heat, bringing the total generation by element III-B to 177.3 Mw-hr. Release data on Kr and Xe were calculated for the first 160 Mw-hr of element III-B operation. It appears that the release rate is still on a slight increase but that it will probably level off at less than 5×10^{-3} for each of the noble-gas isotopes studied. Another calculation was made of the effective permeability of the III-B sleeve for Kr and Xe. Results were in essential agreement with previous calculations. Analyses were made of plateout sleeves that were installed in the in-pile loop during element III-B operation and of the purge and bypass piping

from element III-A. Results provided information on plate-out, and on decontamination of HTGR system components. The analysis of experimental data from the small-scale nuclear mockup of the Peach Bottom core was completed. Comparison of the experimental results with those from the calculational program indicates that the analytical methods are very reliable. The gross reactivity of the assembly was calculated within 0.5%, power distribution within 10%, control-rod worth within 10%, and the temperature coefficient within 12%. In general, the uncertainty of the calculations is no greater than the uncertainty of the experimental measurements. A calculation was made to determine the magnitude of the flux filt that would be produced if one or two of the control rods in the outer two rings were stuck in the core. Additional calculations were made to determine the effect of such flux tilts on reactor flux instrumentation. Results showed that the reactor instrumentation can easily detect the presence in the core of these outer rods, which are usually withdrawn during power operation. Corings were made and analyzed to determine the radical Ba-concentration profiles of the sleeves in several reduced-scale Ba-permeation experiments, as well as in the full-diameter experiment. The full-diameter experiment, which was in operation for a total of 1509 hr, is continuing. Results of the most recent run give a Ba evaporation rate of 2.4×10^{-15} g/cm^2-sec, a value which is consistent with earlier runs and with the results of the reduced-scale experiments. Ba-concentration profiles from a number of the reduced-scale experiments were analyzed to determine the diffusion coefficient of Ba in HLM-85 graphites. Results indicate that the diffusion coefficient is about 2×10^{-9} cm^2/sec at 1000°C. A diffusion coefficient of this order of magnitude would provide sufficient delay in the sleeve to reduce the escape of Ba^{140} into the main coolant stream to a negligible value at the low Ba-concentration level expected in the reactor. Studies on reactor hazards during the quarter include the modification of the RETAIN code, and the completion of a code that will permit a systematic compilation of experimental data on Xe^{133} release. (auth)

22854 (GEAP-3935) FUEL CYCLE PROGRAM. A BOILING WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report No. 7, January 1962–March 1962. J. A. Hodde, comp. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 30, 1962. Contract AT(04-3)-189. 71p.

Activities in an integrated investigation in the VBWR and other facilities to improve the technological limits of boiling reactors are reported. In work on advanced fuel power tests, reduction of VBWR stability test data is almost complete. Information is also included on the irradiation status of fuel assemblies and operation of defected fuel tests. Results of UO_2 conductivity tests in the center melting calibration assembly are reported. In research on heat transfer and fluid dynamics, a seven-rod test section was fabricated for investigation of differences between single- and multi-rod burnout heat flux. Measurements of fuel isotopic composition indicate that the capture of neutrons by U^{238} to form Pu^{239} may have been underestimated. (J.R.D.)

22855 (LAMS-2875) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING FEBRUARY 20, 1963. (Los Alamos Scientific Lab., N. Mex.). Mar. 1963. Contract W-7405-eng-36. 16p.

Operation of LAMPRE I is summarized, and predictions of power and temperature transients by a new Fortran code (LTC) are compared favorably with experimental results. LAMPRE fuel capsules were metallographically examined and revealed Na attack of weld metal surfaces as well as intergranular penetration of Pu-fuel in the heat-affected zone of the welds. New techniques were developed for fabricating capsules. Several alloys were investigated. Corrosion tests of Ce–Co–Pu alloys in Ta showed an increase in C content to reduce Ta_6Co_7 layer formation. High Co contents in Ce–Co alloy produced an increased Co–Ta film growth. Tests on yttrium capsules containing Mn–U and Mn–Pu–U alloys showed the Pu to increase the corrosion resistance of Y to Mn–U fuels. Methods for fabricating and preparing plutonium alloys were developed. Status of the core test facility is reported. Several Pu alloy systems were also examined, mainly to gain information on phase relations in Pu alloys. Decomposition, lattice parameters, solubility, phase diagrams, and formation reactions were among the examined properties of the C–O–Pu, Eu–Pu, La–Pu, N–Pu, Pr–Pu, Pu–Sc, and Pu–Y systems treated. (D.C.W.)

22856 (LAMS-2894) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING MARCH 20, 1963. (Los Alamos Scientific Lab., N. Mex.). Apr. 1963. Contract W-7405-eng-36. 20p.

Construction progress on the Ultra High Temperature Reactor Experiment (UHTREX) facility is reported. Progress is also reported on studies of irradiation damage to baked carbon, shutdown rod development, design of fuel-transfer gas locks, assembly of a core flow model, development of the gas cleanup system, blower development, and dynamic system analysis. (M.C.G.)

22857 (MND-2903(Vol.I)) FEASIBILITY STUDY OF WATER-COOLED THERMIONIC NUCLEAR POWER PLANT. (Martin-Marietta Corp. Aerospace Div., Baltimore). Nov. 1962. Contract AT(30-1)-2990. 205p.

A justification, description, and evaluation of a water-cooled thermionic plant are presented. A comparison among various concepts is made, and a justification for the selected plant is given. A conceptual design of the selected plant is presented along with an evaluation of the characteristics and performance of this plant. The costs of building and operating the plant are based on the assumption that this plant is one of ten produced. A discussion of the results, conclusions, and the studies conducted during the program is included. Detailed descriptions of fuel element geometry, thermionic diode analysis, system control analysis, reliability, and transportability of the plant are also included. (auth)

22858 (NP-12724) BERECHNUNG VON THERMODYNAMISCHEN KREISLÄUFEN UND OPTIMIERUNG DER GASTEMPERATUREN FUR GASGEKUHLTE KERNREAKTOREN. (Computation of Circulation Thermodynamics and Optimization of Gas Temperature for Gas-cooled Nuclear Reactor (thesis)). Herbert Hammer (Berlin. Technische Universität). 1962. 111p.

The ascertainment of the optimal coolant inlet and outlet temperatures as well as the optimal pressure drop in the primary circulation system for the construction of gas-cooled power reactors is discussed. Reactors with cylindrical fuel elements and high-temperature reactors were considered. Topics covered include: primary circulation system of the gas-cooled reactor, circulation of the work medium, and the current generation costs. (M.C.G.)

22859 (TID-18526) PRELIMINARY ANALYSIS [OF] LOSS OF POWER ACCIDENT. HAZARDS ANALYSIS. D. Lampe (Allis-Chalmers Mfg. Co. Atomic Energy Div.,

Washington, D. C.). Aug. 31, 1960. Contract [AT(10-1)-925]. 104p. (EGCR-STUDY-IV-311)

The minimum flow of helium at normal reactor-operating pressure required to cool the EGCR following a complete power failure is estimated and a detailed method for definitive determination of this flow using an analog computer to enable consideration of transients associated with the accident is proposed. The minimum required flow is defined as that flow that will prevent fuel-element failures as a result of excessive temperatures and will prevent over-heating the reactor-vessel temperature barrier, the reactor outlet-coolant piping, and the steam generators. Results indicate that natural circulation coolant flow rates will not adequately cool the EGCR following a loss-of-power accident and that the estimated flow required following the loss-of-power accident is 5% of full-power flow. This flow must be supplied within 2.0 minutes after a complete power failure. (auth)

22860 (TID-18527) LOSS OF POWER ACCIDENT. HAZARDS ANALYSIS. D. A. Lampe, L. L. Kintner, and W. G. Sutton (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Jan. 30, 1961. Contract [AT (10-1)-925]. 80p. (EGCR-STUDY-IV-311-2)

A study was performed to determine if the coolant outlet temperature would exceed the 1150°F limitation during a loss of plant power without forced cooling. Results indicate a scram on loss-of-power should be included in the EGCR safety to prevent excessive outlet temperatures in such an occurrence. (auth)

22861 THE WINDSCALE ADVANCED GAS-COOLED REACTOR. Atom, No. 78, 76-80(Apr. 1963).

A description of the Windscale Advanced Gas Gooled Reactor is given. The economic potential and operational parameters are considered. The main objectives and major design features are discussed. Brief descriptions of the various components of the reactor and the experiments that will be performed are given. (C.E.S.)

22862 THE OVERALL PLANNING OF NUCLEAR AND CONVENTIONAL POWER STATIONS IN ONE SUPPLY GRID. A. A. De Boer (Euratom-Kommission, Brussels). Atomwirtschaft, 8: 7-11(Jan. 1963). (In German)

The question of the most advantageous introduction of nuclear energy so that it can carry an optimum proportion of the total capacity is discussed. The costs are studied on a model based on a supply grid consisting of several nuclear and conventional power stations. The combination of production capacities and distribution, which leads to the lowest costs for the entire system, is calculated. As new power stations are introduced to cover the basic load, the operating life of the older stations is reduced and the per unit generating costs are increased. The dependence of the level of prime costs of various kinds of power on the operating life and the dependence of the operating life of conventional power stations on that of the new nuclear power stations are examined. Because of the preparation needed, plans must be begun ten years before the capacity is required. There is a strong tendency toward large power stations. (J.S.R.)

22863 WHAT CONFIDENCE IS TO BE PLACED IN INDUSTRIAL INFORMATION IN THE PLANNING OF A NUCLEAR POWER PLANT? Heinrich Mandel (Rheinisch-Westfälisches Elektriztitätswerk AG, Essen, Ger.). Atomwirtschaft, 8: 12-16(Jan. 1963). (In German)

There are nine factors concerning the generating costs that must be known in the planning of a nuclear power plant: installation costs, interest rate, depreciation period, personnel costs, costs of maintenance and waste disposal, full load availability and effective number of operating hours at full load; costs of fuel core and replacement, attainable degree of burn-up, and net refund value of spent fuel elements. A discussion of these factors shows that the greatest financial risks are concerned with the economic life of the station, the cost of maintenance and waste disposal, full load availability, burn-up, and net refund values. (J.S.R.)

22864 OPERATIONAL EXPERIENCE WITH THE DRESDEN NUCLEAR POWER PLANT. A. Weckesser (Versuchsatomkraftwerk Kahl GmbH, Ger.). Atomwirtschaft, 8: 17-22(Jan. 1963). (In German)

The Dresden power plant after $2\frac{1}{2}$ years of operation with only one six-month shut-down has furnished important practical data for the construction of other large boiling water reactors. The shut-down was occasioned by the malfunctioning of two control rods. Investigation showed the coupling piece was broken. Replacement of these couples in all control rods was made using steel with a heat treatment that would avoid stress corrosion cracking. New results on the thermal conductivity of UO_2 and additional burn-up studies have permitted the maximum heat flux of the fuel elements to be increased so that the capacity could be raised to 200 Mwe. The stability of the reactor was proved in a special test in which the normal steam bubble content was allowed to double. There was some difficulty with leaks in the circulating pumps, preheaters, and medium pressure part of the turbines. (J.S.R.)

22865 THE GERMAN NUCLEAR SHIP PROJECT OF KERNENERGIE HAMBURG. Atomwirtschaft, 8: 23-6(Jan. 1963). (In German)

An order for the construction of a 15,000-tdw ore freighter in which a reactor with a capacity of 10,000 hp(th) is to be installed was placed in November 1962. The ship will have a displacement of 25,950 tons with a draught of 9.2 m and an overall length of 157 m. It should attain a speed of 15.75 knots. A special feature of the construction is the protection of the compartments containing the reactor with its safety shield and service area against the effects of collision, foundering, and grounding. Special measures are being taken to prevent contamination of the sea if the ship should sink. Fuel elements can be stored safely in the service area until they are loaded. There will be living accommodations for a basic crew of 60 and for 53 scientists and trainees. Because of difficulties in the operation of OMRE reactor, originally intended for the ship, no definite order for the reactor has been placed. Design contracts were let for a pressurized water reactor and a pressurized water reactor with local boiling, either of which could be installed in the reactor compartment of the ship. (J.S.R.)

22866 NUCLEAR ENERGY IN SWEDEN. Harry Brynielsson (AB Atomenergi, Stockholm). Atomwirtschaft, 8: 51-4(Feb. 1963). (In German)

The organization of the official and semi-official bodies in Sweden working with nuclear energy is summarized. Studies on the potential power need for Sweden indicated that approximately 4000 Mw would be needed by 1980. It is the purpose of reactor research in that country, therefore, to develop reactors suited to Swedish conditions and which can be constructed within the country. Preliminary studies on the selection of reactor type favored natural or only slightly enriched uranium heavy water moderated reactors

with a pressure tank. The reactors currently under planning or construction are reviewed, and current investigations on fuel elements and reactor components are indicated. (J.S.R.)

22867 THE INTRODUCTION OF NUCLEAR ENERGY INTO THE SWEDISH ELECTRICAL GENERATION AND DISTRIBUTION SYSTEM. Olle Gimstedt (Atomkraftkonsortiet, Stockholm) and Ingvar Wivstad. Atomwirtschaft, 8: 55-7(Feb. 1963). (In German)

The electrical production and consumption in Sweden at the present time are reviewed briefly with an estimation of future needs. The proposals being made for the supply of future needs by hydroelectric, conventional, and nuclear energy plants are summarized in tabular form and discussed. Three nuclear power plants now in operation or under planning and construction—the Ågesta, Marviken, and Simpevarp—are described. (J.S.R.)

22868 THE SWEDISH NUCLEAR INDUSTRY. Curt Mileikowsky, Lars Leine, and Ake Molin (ASEA, Västerås, Sweden). Atomwirtschaft, 8: 58-60(Feb. 1963). (In German)

Because of Sweden's capacity to manufacture precision products and to develop advanced equipment and processes, the country is well qualified to undertake the development and construction of nuclear installations. The nuclear energy divisions set up by a few private firms to do development and construction work and to supply reactor plants or specialized equipment are described. The role that they have played in the construction of the Ågesta and Marviken power plants was emphasized. 95% of the Ågesta plant was manufactured in Sweden. The difficulties in the Swedish development of a heavy water pressurized tank reactor are considered, and it is believed that up to 80% of the development work done in other countries on light water reactors will be applicable. (J.S.R.)

22869 REACTOR DEVELOPMENT IN SWEDEN. P. H. Margen (AB Atomenergi, Stockholm). Atomwirtschaft, 8: 63-7(Feb. 1963). (In German)

Data on the Swedish power reactors are presented in tabular form as an introduction to a discussion of the possible future development from the Ågesta power plant. Improvement of the pressurized heavy water reactors by increase in output, improvement of control properties, and component development is the first study undertaken. The second stage would be the advance to boiling heavy water reactors with direct cycle and natural circulation. As a result of the BASHFUL study on this design, it was decided to redesign the Marviken power plant as a 200-Mwe boiling heavy water reactor with internal superheating. The principal development work being done on this reactor design is indicated. (J.S.R.)

22870 DEVELOPMENT OF NUCLEAR ENERGY IN FINLAND. Erkki A. Laurila (Technische Hochschule, Otaniemi, Finland). Atomwirtschaft, 8: 78-9(Feb. 1963). (In German)

The relatively modest Finnish program for the development of nuclear energy is not due to an underestimation of the significance of this energy source for the Finnish economy. The reasons for the slow development are discussed briefly. The present Finnish policy with respect to nuclear power development is indicated. (J.S.R.)

22871 THE ENERGY SITUATION AND THE NUCLEAR INDUSTRY IN DENMARK. Hans Harboe (DANATOM, Copenhagen). Atomwirtschaft, 8: 84-5(Feb. 1963). (In German)

The lack of an internal electrical grid connection between east and west Denmark creates a problem because of the necessary limitation on the size of the nuclear power plant that can be used. Three studies based on reactor types already developed in other countries were made. In addition to the ship reactor, the BETA project investigated a 175-Mwe gas-cooled, graphite-moderated reactor, and the Gamma project studied a 210-Mwe boiling water reactor. This was later developed as Project Gamma-II with internal steam separation, forced circulation, and a pressure vessel of reinforced concrete. The cooperation of private industry in the construction at Risö is indicated. (J.S.R.)

22872 DANISH SHIP REACTOR STUDIES. Sven Werner (Burmeister & Wain A/S, Copenhagen). Atomwirtschaft, 8: 87-8(Feb. 1963). (In German)

The first study of nuclear propulsion for merchant vessels in Denmark made an economic comparison with turbine or diesel propulsion for a tanker of 65,000-tdw with 25,000 shp and a speed of 17 knots. A pressurized water reactor with a capacity of 77 Mwt was the reactor type considered. A revised study was then made to take into consideration the reactor developments made since 1960. The same reactor type with local boiling was used. The spherical pressure vessel was replaced by a pressure-suppression system with tube condensers in the reactor space. The studies indicated that at the present time a nuclear ship would cost 25 to 30% more to build in Denmark than a turbine-driven tanker. (J.S.R.)

22873 NUCLEAR ENERGY IN NORWAY. Gunnar Randers (Institutt for Atomenergi (IFA), Kjeller, Norway). Atomwirtschaft, 8: 117-18(Feb. 1963). (In German)

The Norwegian nuclear power program has concentrated on the study of the boiling water (light and heavy) reactor to determine the optimum use of this system. Extensive studies are also being made on the reprocessing of fuel elements for such reactors. (J.S.R.)

22874 THE HALDEN BOILING HEAVY WATER REACTOR—HBWR. Roar Rose (IFA-OECD-Halden Reactor Project, Halden, Norway). Atomwirtschaft, 8: 123-6 (Feb. 1963). (In German)

The HBWR is a natural circulation boiling water power reactor in which heavy water circulates by natural convection of the moderator-coolant. In $4\frac{1}{2}$ yrs of operation, it has had two different fuel charges. The first charge consisted of nearly 300 elements made up of a single rod of natural U canned in a balanced 2 S Al alloy. The second fuel charge consisted of 100 assemblies of sintered pellets of 1.5% enriched UO_2, canned with Zircaloy-2. The maximum power levels were 5 and 20 Mw for the first and second charge, respectively. The corresponding maximum temperatures were 150 and 230°C. The first part of the experimental program for the first fuel loading was devoted to reactor statics–steam void reactivity and distortion in thermal neutron flux. The dynamic behavior was investigated by studying the response of nuclear power and primary and secondary pressure and flow to introduced reactivity and steam load perturbations. The research program of the second loading is similar to the first, but with the addition of the application of an instrumented fuel channel. (J.S.R.)

22875 THE DEVELOPMENT OF NUCLEAR SHIP PROPULSION IN NORWAY. J. Wilhelmsen, Jr. (Institutt for Atomenergi (IFA), Kjeller, Norway). Atomwirtschaft, 8: 130-2(Feb. 1963). (In German)

An early assessment of the economic implications of

nuclear propulsion was carried out in 1955 and 1956. Because of its potential cycle simplicity, interest was focused on the boiling water reactor. A study was then made of a 65,000-tdw tanker with a 75-Mw indirect cycle marine boiling water reactor. Emphasis was placed on the dynamic behavior of the reactor in a seaway, safety and hazards analysis, and heat transfer conditions for the primary system. On the basis of the first design, a series of optimization works were initiated, but uncertainties connected with MBWR dynamics led to the design of a flexible experimental MBWR station within a spherical container. A 15,000-tdw bulk carrier, powered by a 25-Mw forced circulation, indirect cycle MBWR was studied. (J.S.R.)

22876 WR-1 FITS ORGANIC COOLANT TO CANADIAN PROGRAM. F. W. Gilbert (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. Nucl. Tech., 2: No. 2, 37-9(1963).

WR-1, a 40- to 60-Mw test reactor to be built at Whiteshell, is intended for development work on organic-cooled reactors. The reactor design is described briefly. The advantages and disadvantages of organic coolants are outlined. (D.L.C.)

22877 IS NUCLEAR POWER COMPETITIVE? S. Baron (Burns and Roe, New York). Elec. World, 159: No. 13, 24-26(Apr. 1, 1963).

A treatment is presented of the probable coal and nuclear fuel costs in the future. The mining and transportation components of coal costs and their probable future behavior are considered. The principal factors making up nuclear fuel costs are also discussed in detail: fabrication, reprocessing, use charges, transportation, and plutonium credit. A table of forecast nuclear costs for the years 1962 to 1990 is presented with both pessimistic and optimistic values, and the costs are compared graphically with forecast coal costs. (D.L.C.)

22878 RADIATION AND SHIELDING MEASUREMENTS DURING THE COMMISSIONING OF THE EXPERIMENTAL NUCLEAR POWER REACTOR KAHL. PART I. INTRODUCTION. H. G. Fendler (Allgemeine Elektrizitäts-Gesellschaft, Frankfurt am Main), G. Knoerzer, and M. Oberhofer. Kerntechnik, 5: 41-3(Feb. 1963). (In German)

After a few considerations, descriptions are given of the reactor installations (Boiling Water Reactor) of the Experimental Nuclear Power Reactor Kahl. (auth)

22879 RADIATION AND SHIELDING MEASUREMENTS DURING THE COMMISSIONING OF THE EXPERIMENTAL NUCLEAR POWER REACTOR KAHL. PART II. MEASUREMENTS IN THE CONTAINMENT. H. G. Fendler (Allgemeine Elektrizitäts-Gesellschaft, Frankfurt am Main), G. Knoerzer, and M. Oberhofer. Kerntechnik, 5: 43-8 (Feb. 1963). (In German)

The measurements of the first dose rates in the containment were started at small and medium thermal reactor power levels (300 kw to 15 Mw). The aim of the measurements was to find out as soon as possible places where dangerous radiation fields were to be expected. Particularly strong radiation fields were localized, as expected at the following places: in the heat exchanger room and in the forced circulation rooms. The dose rate readings which were obtained for small and medium values of the reactor power were extrapolated as far as the full power. The resulting readings for the measuring points over the reactor pressure vessel and in the control rods room were higher than the calculated ones. The latter fact was also confirmed by the measurements performed at a power level of 36 Mw and 41 Mw respectively. (auth)

22880 RADIATION AND SHIELDING MEASUREMENTS DURING THE COMMISSIONING OF THE EXPERIMENTAL NUCLEAR POWER REACTOR KAHL. PART III. MEASUREMENTS IN THE CONTROL RODS ROOM, LATTICE MEASUREMENTS AND MEASUREMENTS OUTSIDE THE REACTOR CONTAINMENT. H. G. Fendler (Allgemeine Elektrizitäts-Gesellschaft, Frankfurt am Main), G. Knoerzer, and M. Oberhofer. Kerntechnik, 5: 49-54(Feb. 1963). (In German)

According to the readings in the control rods room, the downwards scattering of intermediate neutrons takes place at the edges at the top of the control rods room. The measurements at points distributed in the form of a lattice on the shielding walls lead to the spotting of several places in the containment which were unsatisfactorily shielded. Outside the containment, high dose rates were found in the canal for the steampipe which goes to the turbine room. During the commissioning period of the reactor no increase in the level of the activity in the surroundings of the reactor was observed. (auth)

22881 FABRICATION, DESIGN AND TESTING OF EQUIPMENT FOR THE EXPERIMENTAL NUCLEAR POWER REACTOR KAHL. W. Ullrich (Allgemeine Elektrizitäts-Gesellschaft, Frankfurt am Main). Kerntechnik, 5: 54-61(Feb. 1963). (In German)

Design requirements, fabrication problems, and tests for containment, reactor pressure vessel, steam generator, sub-cooler, and piping are described. For the design of these parts especially the choice of material was important because of high loading, corrosion, and welding. The problems of fabrication arose from complicated shape, great dimensions, and wall thicknesses and close tolerances. Extensive material testing and quality control were performed to assure satisfactory function and reliability of operation. (auth)

22882 EXPERIENCES IN CIVIL ENGINEERING OF THE EXPERIMENTAL NUCLEAR POWER REACTOR KAHL. R. Hemmleb (Hochtief A. G., Frankfurt am Main). Kerntechnik, 5: 62-3(Feb. 1963). (In German)

Experiences are reported which are made since the start of the Experimental Nuclear Power Reactor Kahl concerning the civil engineering of the nuclear sector. The short information refers to some details of insolation, shielding against radiation, demountable walls, decontamination, and general planning. (auth)

22883 THE HEAT REMOVAL SYSTEM OF THE O.E.C.D. HIGH TEMPERATURE REACTOR DRAGON. H. W. Mueller and H. Uschwa (Atomic Energy Establishment, Winfrith, Dorset, Eng. and Borsig A. G., Berlin). Kerntechnik, 5: 66-71(Feb. 1963). (In German)

At first, it is mentioned how the objectives of the European High Temperature Reactor Dragon have determined the layout and design of the heat removal system. The basic arrangement of all the heat removal circuits is outlined in a heat flow diagram. The most important design parameters are listed. Special design features of the most important components are discussed, and operation and safety aspects are considered. (auth)

22884 DEVELOPMENT OF CONTROL ROD DRIVES FOR BOILING WATER REACTORS. H. Acher (Allgemeine Elektrizitäts-Gesellschaft, Frankfurt am Main). Kerntechnik, 5: 71-5(Feb. 1963). (In German)

Starting with the basics of physical and control techniques it is reported on the most suitable arrangement of control rod drives in a boiling water reactor. Considering the type of reactor, the operational requirements, and the effect of the drive on the entire plant size and consequently on the

plant cost, some drive systems preferred in present practice are arrived at. In particular, the drive system is selected with view to the question whether the control rod drive is applied in a single cycle or dual cycle boiling water reactor. Moreover, reference is made to the design description of 3 AEG control rod drives and to the advantages resulting from the application of two different types of control rod drives in a boiling water reactor. Finally, the AEG control rod drives test facility is described together with a wear test rig for various material tests performed according to a time reducing procedure. (auth)

22885 AGR—A BRIEF EVALUATION. Nucl. Eng., 8: 115-21(Apr. 1963).

A brief description of the Windscale Advanced Gas Cooled Reactor is presented. Information on the design objectives, commissioning, and development potential is included. Safety and economic performance are considered. Tables containing the main parameters and performance data, initial operating conditions, and general parameters for the 500-Mw reference design are included. (C.E.S.)

22886 NUCLEAR POWER PLANT AVAILABILITY. G. Hefferon (American Machine and Foundry Co., Greenwich, Conn.). Nucl. Eng., 8: 122-6(Apr. 1963).

Several practical methods for calculating the ratio of on-line time to total operating time are given. This ratio is termed the plant availability. Results of a sample calculation for the pressurized water plant PM-1 are shown. A simple system for processing failure frequency and repair time data in an existing plant is described. Two computer codes are included that were developed to carry out the calculations for the availability analysis and the data processing work. (C.E.S.)

22887 IN SWEDEN TODAY. AN APPRAISAL OF THE NUCLEAR POWER PROGRAMME. Nucl. Eng., 8: 127-32 (Apr. 1963).

A brief summary of Sweden's activities in the nuclear field is given. Information on the research and power reactors is outlined. Future plans are also discussed. (C.E.S.)

22888 THE AGESTA REACTOR. Nucl. Eng., 8: 133-4(Apr. 1963).

A general survey of the Agesta reactor is given. The main parameters of the plant and core are listed. A description of the core, pressure vessel, pressurizer and relief system, and fuel handling is included. (C.E.S.)

22889 PROBLEMS FACED DURING CONSTRUCTION. Nucl. Eng., 8: 157-63(May 1963).

Some of the problems faced during construction of the Berkeley plant are discussed in detail. They include the site, shielding, pressure vessel, primary circuit, blower leaks, core changes, control modifications, boilers, surface treatment, instrumentation, and pile-cap machinery. The final commissioning and operation of Berkeley are described, and its main parameters are tabulated. (D.L.C.)

22890 A HARD-WON ACHIEVEMENT. Nucl. Eng., 8: 164-7(May 1963).

A table of the main parameters of the Bradwell plant is presented, and the approach to the construction program is outlined. The problems encountered in the construction are described. They include core design modifications, changes in control systems, fuelling machinery, burst cartridge detection equipment, and safety system. The commissioning program is described briefly. (D.L.C.)

22891 AEA FUEL PRODUCTION. K. J. Norman and J. Exley. Nucl. Eng., 8: 168-9(May 1963).

The development and design of the fuel used in the Bradwell and Berkeley stations are described briefly with reference to the Calder Hall fuel. The fabrication of the fuel at Springfields and transport to the stations are also discussed. Future developments in magnox fuel are considered. (D.L.C.)

22892 NUCLEAR PROPULSION OF SHIPS. UNITED KINGDOM ATOMIC ENERGY AUTHORITY, MARINE REACTOR PROJECT. Nucl. Energy, 116-26(May 1963).

In the first phase of the research program, two integral-reactor designs were selected for further study: the Vulcain pressurized-water reactor and the Integral Boiling Reactor. The details of each design are described, and expected development problems are discussed. The time scale of the project, costs, and reasons for the choice of integral reactors are also considered. (D.L.C.)

22893 FAILED-FUEL-ELEMENT DETECTION SYSTEM IN CVTR. Harold T. Babb (Carolinas-Virginia Nuclear Power Associates, Columbia, S. C.) and Roger Eastman. Nucleonics, 21: No. 5, 74; 76(May 1963).

A method for detecting and locating defective fuel elements for removal with a minimum amount of shutdown time is described. To do this job at Carolinas-Virginia Tube Reactor a failed-element detector and locating system was designed and built that can accurately locate failures in the fuel elements. This system can be adopted for any pressure-tube reactor. (C.E.S.)

22894 SIMULATING SIZEWELL REACTOR TRANSIENTS WITH AN ANALOG COMPUTER. S. M. Davies (English Electric Co., Ltd., Whetstone Leicester, Eng.). Nucleonics, 21: No. 5, 88-93(May 1963).

The Saturn analog computer was used to study the time-dependent equations that describe the control, stability, safety, and operational features of the reactors in the 580-Mev Sizewell nuclear power station. A single fuel channel in the flattened-flux region in which power and temperatures are maximal was simulated. A set of equations was formulated to represent the particular features of the reactor. (C.E.S.)

22895 REACTOR CORE-TOP DUMMY ASSEMBLY FOR EGCR (Engineering Materials). (Oak Ridge Operations Office. Reactor Div., AEC). 3 drawings. (CAPE-972)

The Experimental Gas Cooled Reactor utilizes 234 of these assemblies. Each assembly, which is installed at the top of a fuel channel in the reactor core, serves as an orifice for moderator coolant annulus flow. The assembly also serves as a lock at the top of the fuel column to prevent upward displacement of the fuel assemblies in the reactor core fuel channels. The core-top dummy assemblies must withstand a He environment of 1050°F and 305 psia. (F.L.S.)

22896 REACTOR VESSEL FOR THE EGCR (Engineering Materials). (Oak Ridge Operations Office. Reactor Div., AEC). 61 units. (CAPE-973)

The reactor pressure vessel for the Experimental Gas Cooled Reactor is approximately 20 ft in diam. and 46 ft high, and is the pressure-tight containment for the reactor core. The vessel consists of a $2\frac{3}{4}$ in. carbon steel plate shell and an inner temperature-barrier shell of 1 in. stainless steel. The pressure vessel is designed to withstand 350 psig and a temperature of 650°F. Also included in this package are restraint rings, core grid structure, and the core bottom plate. The 3 core-peripheral-restraint rings are of Cr–Mo steel and are used to limit bowing of the graphite columns and assures core integrity in the event of column breakage. The core grid structure

is used to position the lateral restraint lattice to transmit seismic loads to the reactor vessel, and to support the core cover plates, fuel channel extensions, burst-slug detection system, and the piping and instrument heads. The core bottom plate supports the reactor core, locates and restrains the graphite columns, and supports the fuel assemblies. (F.L.S.)

22897 KERNENERGIE UND KERNKRAFTWERKE. (Nuclear Energy and Nuclear Technology). Dietmar Albert. Leipzig, VEB Fachbuchverlag, 1962. 176p. 4.50 DM.

The principles of physical calculations for reactors are presented. The elapsing fission reactions in a reactor are considered. From that it is shown that the reactor must consist not only of fissionable material, but also of construction materials with various functions, the coolant for removal for energy released as heat in nuclear reactions, the control rods for regulation of the desired reactor power, and the radiation shielding. The functions of these individual parts are described thoroughly. Power reactors and nuclear power plants are considered. Peaceful uses of nuclear energy are discussed. (M.C.G.)

22898 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENT HOLDERS FOR BOILING-WATER ATOMIC REACTORS. (to Commissariat a l'Energie Atomique). British Patent 924,213. Apr. 24, 1963. Priority date Aug. 8, 1958, France.

A fuel element holder for boiling reactors is designed which results in some steam–water separation. The holder comprises a fuel element support, a cylindrical member extending from the support, a frustoconical bush on top of the member, and a plurality of radially directed fixed distributor blades in the large base of the bush. The distributor blades impart a rotary movement to the steam–water mixture, thereby directing the water towards the bush walls for discharge through orifices therein. (D.L.C.)

22899 EMERGENCY COOLING OF A NUCLEAR SUPERHEATER REACTOR. H. Kornbichler (to Licentia Patent-Verwaltungs-GmbH). German Patent DAS 1,143,936. Feb. 21, 1963. Filed Mar. 25, 1960.

A device is described for removing the after-glow heat in case of failure in the main circuit. The device consists of a separate emergency circuit, an emergency condensator, and a fast-acting valve located in the duct between the nuclear reactor and the emergency condensator. In series with the said valve there is a second controllable valve. The opening of this second valve is continually adjusted in correspondence with the amount of steam flowing momentarily through the consumer. (Gmelin Inst.)

22900 BOILING WATER REACTOR WITH ROD-LIKE FUEL ELEMENTS. André Huet. German Patent DAS 1,144,412. Feb. 28, 1963. Priority date, Nov. 14, 1957, France.

A boiling water reactor is given which consists of fuel element rods and of devices within the reactor pressure vessel for separating the fluid and the steam. The steam-water separators are located within the elongated spaces between the fuel element rods and consist of a hollow tube to the surface of which there is attached a screw-like shaped plate in such a way as to form a whirl-chamber in the space between the surface of the fuel elements and the tubes. The tubes are provided with a plurality of openings through which the steam, being separated from the water by centrifugal force, passes to flow out the top of the tube. The shape of the cross section of the steam-water separators is matched to that of the spaces. (Gmelin Inst.)

22901 EMERGENCY CONDENSATOR FOR BOILING WATER REACTORS. H. Kornbichler (to Licentia Patent-Verwaltungs-GmbH). German Patent DAS 1,145,722. Mar. 21, 1963. Filed Jan. 29, 1960.

An auxiliary circuit with an emergency condensator is given which acts as a standby to remove after-glow heat. In nuclear reactors in which a pressure-suppression containment provides for venting into a water pool the steam-water mixture that would be released in the event of a break in the primary system and in which the inside of the pressure vessel is subdivided by a perforated horizontal partition-wall on which rests the water pool, it is of advantage to locate the cooling spirals of the emergency condensator within the water pool. In this case it is not necessary to provide a separate container for the coolant of the emergency condensator. (Gmelin Inst.)

22902 NUCLEAR POWER PLANT. Joseph C. Carter, Robert H. Armstrong, and Marion J. Janicke (to U. S. Atomic Energy Commission). U. S. Patent 3,089,840. May 14, 1963.

A nuclear power plant for use in an airless environment or other environment in which cooling is difficult is described. The power plant includes a boiling mercury reactor, a mercury-vapor turbine in direct cycle therewith, and a radiator for condensing mercury vapor. (AEC)

Production Reactors

22903 (CEA-2258) EXPERIENCE D'EXPLOITATION DES REACTEURS DE MARCOULE. (Operational Experience of the Marcoule Reactors). F. Conte (France. Commissariat à l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1963. 21p.

The results obtained from three years operation of the reactors G 2 and G 3 made it possible to accumulate a considerable amount of operational experience of these reactors. The main original points, pre-stressed concrete casing, possibility of loading while under power, and automatic temperature control, were justified by the results of operation. The importance of these original solutions are confirmed and conclusions drawn concerning the study of future nuclear power stations. (auth)

Research Reactors

22904 (AEET/ROD-3) CORROSION AND DEPOSITION PROBLEMS IN CANADA INDIA REACTOR FUEL ROD CLADDING. V. Surya Rao, V. V. Kothare, J. Shankar, and K. S. Venkateswarlu (India. Atomic Energy Establishment, Trombay). 1962. 30p.

A review of operation of the reactor is presented along with a report of corrosion problems. Discussions are included concerning the feed and bleed system, radiation effects on dichromate solutions, mechanism of deposit formation in coolant channels, and removal of deposits from the fuel rods. (J.R.D.)

22905 (BRL-1438) CALCULATION OF RADIATION DOSE LEVELS FOR THE ARMY PULSE EXPERIMENTAL REACTOR ASSEMBLY. Frederick H. Gregory (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Nov. 1962. 31p. (AD-402147)

Calculations are made to estimate, as a function of distance, the radiation dose levels which would occur during full-capacity operation of the Army Pulse Reactor Assembly (APRA). Calculations of the neutron dose are made by two methods. The first calculation (Method A) is made by

utilizing an experimentally determined effective dose mean free path, which probably includes the effect of ground scattering. The second calculation (Method B) is made by utilizing the result of a Monte Carlo calculation of neutron transmission in air. The results of this calculation indicate considerably higher dose levels than indicated by Method A. Experimental data are available which substantiate the result of Method A. The gamma dose at distances of interest is found to be unimportant when considered in light of the uncertainty in the neutron dose. (auth)

22906 (CEA-2211) CHAÎNE DE PUISSANCE "AZOTE 16" SUR LE CIRCUIT DE RÉFRIGÉRATION DE MÉLUSINE. (A Nitrogen-16 Power Channel in the Melusine Cooling Circuit). Raphaël Tiberghien (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1962. 99p.

Thesis submitted to Université, Grenoble, France.

A power channel, which is to be used on Melusine, the 2 Mw pool-type reactor built at Grenoble Nuclear Center, is described. It will be used for measuring of N^{16} activity of water after passage through the reactor core. The experimental system as well as the measuring instruments are described. Solutions to problems likely to arise are given. The experimental results show that this power measurement is free from neutron flux local deformations, from control rods position, and from experiments. The power indicated is to ±2% the same as the thermodynamic power. Since May 1962, this power channel is used as a reference for the operation of the reactor. It is also provided for on the Siloé 10 Mw reactor. (auth)

22907 (KFK-130) DIE HOMOGENE VERGIFTUNG DES REAKTORS FR2 MIT BORSÄURE WÄHREND DER NULLENERGIEMESSUNGEN. (The Homogeneous Poisoning of the FR2 Reactors with Boric Acid During the Zero Energy Measurement). M. Diederichs, H. W. Glauner, H. Graebner, and D. Wintzer (Kernforschungszentrum, Karlsruhe, Germany). July 1962. 46p.

The physical and chemical principles involved in the poisoning of the FR2 Reactor with boric acid during zero-energy measurements are discussed. Preliminary tests with boron in the laboratory and in the reactor are described. Boron poisoning and the accomplishment of physical measurements during boron poisoning are discussed. The purification of heavy water to remove all boron is described. (M.C.G.)

22908 (NP-12659) PREDICTED BEHAVIOUR OF THE AGN 201 REACTOR AT HIGH POWER LEVELS (thesis). W. B. H. Cooke (Naval Postgraduate School, Monterey, Calif.). 1961. 80p.

In anticipation of the AGN 201 nuclear reactor's operation at a power of 1000 watts for short periods of time and at 20 watts continuously, a prediction of the behavior during a rapid power rise was obtained from digital computer solutions of the reactor kinetic equations. The experimental and analytical work which provided the coefficients for the equations is outlined. Solutions of the equations indicate the peak power which may be achieved, the time during which 1000 watts may be obtained, and the temperature rise that results. (auth)

22909 (ORNL-TM-456) PRESSURE EQUALIZATION BY FLUID EXCHANGE BETWEEN PARALLEL FLOW CHANNELS. T. G. Chapman and P. N. Stevens (Oak Ridge National Lab., Tenn.). Apr. 1, 1963. Contract [W-7405-eng-26]. 79p.

Hydraulic and deflection analyses of the unequal flow passages in the HFIR control region revealed excessive pressure differentials. A proposal to drill connecting holes between the flow passages initiated an experimental program for investigating the effectiveness crossflow on pressure equalization. Empirical constants for an analytical model and experimental design data on reduction of pressure differentials between channels were obtained. It was determined that crossflow between channels would satisfactorily reduce the pressure differentials. (auth)

22910 (TID-7642) RESEARCH REACTOR FUEL ELEMENT CONFERENCE, SEPTEMBER 17–19, 1962, GATLINBURG, TENNESSEE. (Oak Ridge National Lab., Tenn.). 733p.

Issued in two books.

A total of thirty-seven papers was presented at the conference. Five of these papers have been previously abstracted in NSA. Separate abstracts were prepared for the remaining thirty-two papers. (J.R.D.)

22911 (TID-7642(p.22-37)) GENERAL DESIGN OF THE ARGONNE ADVANCED RESEARCH REACTOR. L. W. Fromm (Argonne National Lab., Ill.).

A general description of the reactor is given. Sections are included on heat removal and auxiliary systems, reactor building, and site arrangement. (J.R.D.)

22912 (TID-7642(p.47-50)) DESCRIPTION AND OBJECTIVES OF THE ATR. A. W. Flynn and R. H. Gordon (Ebasco Services, Inc., New York).

The Advanced Test Reactor is being built to provide a facility in which loop experiments may be conducted in 48-in.-long test holes in neutron fluxes over 10^{15} adjustable as to intensity and spectrum. Refueling time is minimized by provisions for refueling both the core and the loops without removing the reactor head. (J.R.D.)

22913 (TID-7642(p.51-60)) THE NUCLEAR DESIGN OF THE ATR. T. M. Schuler and S. W. Spetz (Babcock and Wilcox Co., Lynchburg, Va.).

The ATR is a 250 Mwt test reactor designed to provide additional experimental loop irradiation space. The core fuel loading consists of fully enriched U_3O_8 dispersed in, and clad with, Al alloy. Lifetime reactivity is controlled by addition of B. Data are included on reactivity balance and control. (J.R.D.)

22914 (TID-7642(p.61-74)) THE MECHANICAL DESIGN OF THE ADVANCED TEST REACTOR FUEL ELEMENT. D. M. Collings and H. D. Ferris (Babcock and Wilcox Co., Lynchburg, Va.).

A brief description of the ATR fuel element is presented. The major mechanical or structural problems encountered in the design of these elements are discussed along with approaches employed to solve these problems. (J.R.D.)

22915 (TID-7642(p.75-88)) THE THERMAL AND HYDRAULIC DESIGN OF THE ADVANCED TEST REACTOR. W. M. Vannoy (Babcock and Wilcox Co., Lynchburg, Va.).

It is noted that the ATR design incorporates features based on MTR and ETR experience, to improve performance and reduce uncertainties in design calculations. A discussion is presented concerning design features, calculations, and the scope and objectives of test programs affecting the thermal and hydraulic performance of the ATR fuel elements and reactor internals. (J.R.D.)

22916 (TID-7642(p.89-98)) NUCLEAR DESIGN OF THE HFIR. R. D. Cheverton (Oak Ridge National Lab., Tenn.).

The High Flux Isotope Reactor (HFIR) was conceived to produce milligram quantities of Cf^{252} annually from a limited supply of Pu^{242} feed material. Reactor versatility

in other uses is achieved in the form of readily accessible beam tubes, engineering irradiation facilities, rabbits, and a variety of reflector through-holes. (J.R.D.)

22917 (TID-7642(p.99-111)) MECHANICAL AND HYDRAULIC DESIGN OF THE HFIR. J. R. McWherter and T. G. Chapman (Oak Ridge National Lab., Tenn.).

The High Flux Isotope Reactor is a light-water-cooled and -moderated system with Al-clad fuel plates and a Be reflector. Mechanical and hydraulic aspects of component design are reviewed. (J.R.D.)

22918 (TID-7642(p.112-37)) BURNOUT HEAT FLUX PREDICTION FOR FLOWING, SUBCOOLED, WETTING LIQUIDS. W. R. Gambill (Oak Ridge National Lab., Tenn.).

A generalized two-term additive prediction method for burnout flux in flowing subcooled, wetting liquids is described in which one term represents the boiling contribution in the absence of forced convection and the other represents the equivalent forced-convection contribution in the absence of boiling. The predictions of this superposition method were compared with all available experimental data for burnout with flowing, wetting liquids in the absence of significant net vapor generation. Results of these comparisons are analyzed. (J.R.D.)

22919 (TID-7642(p.138-51) THERMAL DESIGN OF THE HFIR FUEL ELEMENT. Neil Hilvety and T. G. Chapman (Oak Ridge National Lab., Tenn.).

Criteria involved in establishing the thermal design of the HFIR include power level (100 Mw), fuel element dimensions, and power density. The thermal design of the HFIR fuel element was based on a series of hot-spot parameter studies. Factors considered in the hot-spot analysis were fuel element fabrication tolerances, fuel-plate defects, changes in coolant channel dimensions caused by fuel-plate deflections, and uncertainties in plant operating parameters. Results indicate that HFIR can meet the thermal design criteria. (J.R.D.)

22920 (TID-7642(p.152-81)) FUEL ELEMENTS FOR THE BELGIAN HIGH FLUX TEST REACTOR BR2. PART I. DESIGN AND HYDRAULIC TESTS OF SOME SPECIAL FUEL ELEMENTS. J. Herpin (Brussels. Centre d'Étude de l'Énergie Nucléaire).

A brief description of the BR-2 reactor is given, followed by more extensive descriptions of two special fuel element types. One of these is described as having five concentric fuel tubes without an inner central support tube. The other type is described as having two concentric fuel tubes with an inner central tube which acts as a neutron screen. This design is optimum for fast flux at the experimental specimen assembly. (J.R.D.)

22921 (TID-7642(p.182-96)) FUEL ELEMENTS FOR THE BELGIAN HIGH FLUX TEST REACTOR BR2. PART II. NON-DESTRUCTIVE TESTING OF PLATES. (Brussels. Centre d'Étude de l'Énergie Nucléaire).

It is noted that the BR-2 fuel elements consist of five to six concentric tubes; each tube is formed by assembling three MTR-type fuel plates. Nondestructive testing devices used in connection with past-assembly examinations of these fuel elements are described. Included are descriptions of an ultrasonic tester and a beta-gamma scanner for control of U^{235} homogeneity. (J.R.D.)

22922 (TID-7642(p.197-243)) BOTTLE TYPE FUEL ELEMENT FOR POOL TYPE REACTORS. (France. Commissariat a l'Energie Atomique, Paris; Compagnie pour l'Etude et la Realisation de Combustibles Atomiques, Bonneuil-sur-Marne, France; and Indatom, Paris).

Design of fuel elements for use in pool-type reactors so that each element in an individual tank is connected to the inlet and outlet of the cooling circuit is described. Pool water flows into the fuel element (tapping flow) and is returned to the pool after sufficient decay of short-lived radionuclides, and fixation of its middle and long-lived radionuclides on resins. (J.R.D.)

22923 (TID-7652(p.244-67)) PROTOTYPE STUDIES OF MODIFIED FUEL ELEMENT GEOMETRIES. W. C. Francis and M. L. Griebenow (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

The geometry and proof test aspects of fuel element development are discussed. Work in these areas resolves primarily into a determination of the engineering properties of fuel elements and requires a thorough study of the hydraulic and heat transfer characteristics on which to base an optimum design. The approach discussed involves separate analyses of the strength, hydraulics, and heat transfer in out-of-pile experiments. The most promising concepts are then incorporated into a full-scale prototype for out-of-pile testing followed by in-pile evaluation of the promising design. (J.R.D.)

22924 (TID-7642(p.268-89)) FABRICATION DEVELOPMENT OF THE INVOLUTE-SHAPED HIGH FLUX ISOTOPE REACTOR FUEL PLATES. M. M. Martin, J. H. Erwin, and C. F. Leitten, Jr. (Oak Ridge National Lab., Tenn.).

Fabrication of HFIR fuel plates utilized in the first critical-test elements is described. The dimensional and fuel homogeneity problems imposed by radially grading the U concentration in these elements are also considered. A dispersion-type fuel consisting of 26 wt % U_3O_8 and 0.07 wt % B_4C in Al was selected as the fuel-bearing portion of the plate. A 24 wt % U–Al plate was used in the outer-annulus plate. Various methods for forming the involute-plate contour to the tight tolerances dictated by the element design are evaluated, and factors that affect the duplication of the plate curvature are reported. (J.R.D.)

22925 (TID-7642(p.290-314) ASSEMBLY AND WELDING DEVELOPMENT FOR THE HIGH-FLUX ISOTOPE REACTOR FUEL ELEMENT. J. W. Tackett, J. H. Erwin, C. F. Leitten, Jr., and G. M. Slaughter (Oak Ridge National Lab., Tenn.).

It is noted that the HFIR will operate with an extremely high neutron flux, which in turn necessitates rapid fuel burnup and high heat generation in the core. The rigid structural requirements imposed by these operating conditions on fuel elements are examined. Discussions are included on fabrication techniques associated with the various designs considered. Suitable fabrication procedures meeting the rigid requirements were developed. (J.R.D.)

22926 (TID-7642(p.315-36)) FABRICATION DEVELOPMENT OF THE ADVANCED TEST REACTOR FUEL ELEMENT. R. L. Heestand, C. F. Leitten, Jr., and R. W. Knight (Oak Ridge National Lab., Tenn.).

It is noted that the operational characteristics of the ATR impose rigid requirements on the integrity and radiation stability of the fuel elements for it. Fuel element dimensional requirements were met by varying the initial compact thickness, using compacts in tandem, and cross rolling to obtain the desired widths. The effects of these fabrication parameters on plate quality are discussed. Plates were formed to the required radii by a modified marforming technique and mechanically assembled into element array by roll swaging. (J.R.D.)

22927 (TID-7642(p.337-59)) NONDESTRUCTIVE TESTING OF HIGH-FLUX ISOTOPE REACTOR AND ADVANCED TEST REACTOR FUEL ELEMENTS. Robert W. McClung (Oak Ridge National Lab., Tenn.).

Work toward establishment of a nondestructive testing program for HFIR and ATR fuel elements is described. Most of the work was directed toward the detection or measurement of those conditions that could cause uneven heat distribution leading to premature failures. Studies of ultrasonic evaluation of nonbonded areas between core and cladding are described along with investigation of x-ray attenuation as a tool for measuring fuel concentration variations within fuel plates. Development of electrical impedance techniques for measurement of coolant-channel spacing is discussed. An eddy-current technique was devised for identification of core orientation in the HFIR fuel plates. (J.R.D.)

22928 (TID-7642(p.360-8)) FABRICATION AND TESTING OF A STANDARD TYPE FUEL ELEMENT MADE BY SPOT-WELDING. M. Huberlant (Métallurgie et Mécanique Nucléaires, Mol, Belgium) and D. Tytgat (Brussels. Centre d'Etude de l'Energie Nucleaire).

Development of fuel elements for the BR-2 with six concentric tubes, each tube being formed by three plates assembled by spot welding, is described. Results of tests show that this fabrication method has distinct advantages and that it is well adapted to test reactor requirements. (J.R.D.)

22929 (TID-7642(p.369-75)) A NEW CONCEPT FOR ALUMINUM BASE FUEL ELEMENTS. G. W. Cunningham and S. J. Paprocki (Battelle Memorial Inst., Columbus, Ohio).

Development of methods for fuel loadings into elements in excess of 30 wt % U is discussed. A proposed system consisting of Nb-coated UO_2 fuel and ZrB_2 burnable poison dispersed in Al matrix and clad with Al is described. It is believed that in such a system, higher concentrations of fuel are feasible. Other anticipated advantages include higher radiation and corrosion resistance, improved core-physics characteristics, improved reprocessing characteristics, lowered recycling costs, and improved core composition control. (J.R.D.)

22930 (TID-7642(p.376-97)) FABRICATION OF COMPOSITE PLATE ASSEMBLIES CONTAINING GRADED OR CONTOUR FUEL AND/OR POISON LOADINGS BY POWDER METALLURGY TECHNIQUES. W. R. Weinberger and T. S. Weissmann (Martin-Marietta Corp. Aerospace Div., Baltimore).

Discussions are presented concerning various proposed techniques which may be employed in the fabrication of composite fuel plates containing graded fuel and/or poison materials in such a manner as to offer maximum flexibility to the reactor designer. Techniques considered include those for preparation of graded compacts, contour-shaped compacts, preformed compacts, and powder-rolled compacts. (J.R.D.)

22931 (TID-7642(p.398-424)) FABRICATION AND IRRADIATION OF BONDED FLAT TYPE RODS FOR THE NRU REACTOR. J. S. Nelles (Atomic Energy of Canada Ltd., Chalk River, Ont.).

Fabrication and irradiation testing of Ni-plated U cores bonded to Al cladding during extrusion are described. The fabrication procedures described are representative of the Type 2B NRU flat element. Irradiation conditions are described, and results are tabulated and discussed. (J.R.D.)

22932 (TID-7642(p.444-68)) SOME RESULTS OF URANIUM–ALUMINUM IRRADIATIONS AT THE MTR/ETR. W. C. Francis, G. W. Gibson, and W. P. Scarrah (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

Results of a long-term fuel development program at MTR/ETR to prepare improved fuel compositions for test reactors are discussed. The major portion of the work was devoted to U–Al alloys and Al-clad cermets with the objective of producing high-strength compositions with good high-temperature characteristics. Details of test procedures and results are included. (J.R.D.)

22933 (TID-7642(p.469-88)) RADIATION PERFORMANCE AND INDUCED TRANSFORMATIONS IN ALUMINUM-BASE FUELS. A. E. Richt, C. F. Leitten, Jr., and R. J. Beaver (Oak Ridge National Lab., Tenn.).

Developmental work concerned with optimizing fuel materials for thin-plate Al-base research reactor elements is discussed. A Si-modified 48 wt % U–Al alloy, a dispersion of 62 wt % UC_2 in Al, and a dispersion of 65 wt % U_3O_8 in Al were developed. Results of irradiation testing on both miniature fuel plates and full-sized fuel assemblies composed of these materials are reported. (J.R.D.)

22934 (TID-7642(p.489-548)) EFFECTS OF FUEL BURNUP ON ALUMINUM PLATES REINFORCED WITH FUELED-GLASS FIBERS. R. J. Burian, J. E. Gates (Battelle Memorial Inst., Columbus, Ohio) and R. H. Baskey (Clevite Research Center, Cleveland).

Activities in a program to investigate consolidation of metal-coated fueled glass fibers and to fabricate Al-alloy-clad fuel plates are reported. Results of investigations to determine mechanical properties of clad and unclad fuel-bearing glass core materials at room temperature and at elevated temperatures are also reported along with results of irradiation stability tests on encapsulated fiber-glass materials at flux intensities and degree of burnup expected of MTR fuels. (J.R.D.)

22935 (TID-7642(p.549-64)) MECHANICAL PROPERTIES OF X8001 ALUMINUM CLADDING AND X8001 ALUMINUM-BASE DISPERSION AT ELEVATED TEMPERATURES. W. R. Martin and J. R. Weir (Oak Ridge National Lab., Tenn.).

Results of an investigation of X8001-0 Al alloy mechanical properties are reported. The investigation was conducted to select a cladding material for the ATR fuel elements. The mechanical properties of this cladding, a U_3O_8–Al fuel dispersion, and a composite fuel plate were examined. Data from these investigations are presented. (J.R.D.)

22936 (TID-7642(p.565-87)) ALUMINUM–ALUMINUM OXIDE ALLOY WROUGHT PRODUCTS. J. P. Lyle, Jr. (Aluminum Co. of America. Alcoa Research Labs., New Kensington, Penna.).

A summary of experience with Al–Al_2O_3 cermets is presented. Data and information are included which were derived from experience with large extrusions, impacts, forgings, and forms such as tubes, sheets, and plates at room temperature and at temperatures up to 1000°F. (J.R.D.)

22937 (TID-7642(p.588-600)) OBSERVATIONS ON THE THERMAL STABILITY OF S.A.P. John G. Solomir (Aluminium-Industrie-Aktien-Gesellschaft, Neuhausen am Rheinfall, Switzerland).

It is noted that after long-time annealing at about 500°C, SAP develops surface blisters and microcracks which are associated with gas. The source of the gas, the mechanism

of pore formation, and pore joining are discussed in terms of diffusion and mechanical effects. SAP stability at temperatures above the melting point of Al and high-temperature oxide growth are also discussed. (J.R.D.)

22938 (TID-7642(p.612-34)) THE CORROSION OF ALUMINUM ALLOYS UNDER SIMULATED ATR AND HFIR CONDITIONS. J. C. Griess, H. C. Savage, J. G. Rainwater, J. L. English, and T. H. Mauney (Oak Ridge National Lab., Tenn.).

Results of aqueous corrosion tests on 1100, 6061, and X-8001 Al alloys at very high heat fluxes are presented. The rate of corrosion product buildup was a function of pH and temperature and was independent of heat flux and flow rate within the ranges investigated. At pH 5 a simple empirical equation relates oxide thickness to exposure time and temperature. (J.R.D.)

22939 (TID-7642(p.649-66)) EXOTHERMIC REACTIONS IN Al–U_3O_8 COMPOSITES. J. D. Fleming and J. W. Johnson (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station).

Activities in a program to study the feasibility of forming refractory fuel materials by reactions of Al with U_3O_8 are reported. Exothermic reactions occurring at 1200 to 1900°F depending on composition and processing variables were demonstrated. Parameters associated with these reactions are discussed. (J.R.D.)

22940 (TID-7642(p.667-81)) THE RELATION OF URANIUM HOMOGENEITY REQUIREMENTS TO THE YIELD OF URANIUM–ALUMINUM ALLOY FUEL PLATES. Herbert S. Kalish and Eugene Krinick (United Nuclear Corp. Development Div., White Plains, N. Y.).

Results of a statistical study concerning fabrication of 22.45 wt % Al–U alloy fuel plates are presented. It was found that yields in fabrication of such plates are, in part, a function of the processing rejects resulting from improper plate dimensions, fuel core dimensions, unbonds, and surface conditions. Fuel alloy homogeneity and yields appear to be an intrinsic function of the casting and solidification of the U–Al alloy. (J.R.D.)

22941 (TID-7642(p.682-715)) USE OF CHIP AND SHOT METHODS FOR PRODUCING HOMOGENEOUS ALUMINUM–URANIUM FUEL. W. L. Larson, J. L. Klein, I. B. Roll, and D. S. Kneppel (Nuclear Metals, Inc., West Concord, Mass.).

Results of the investigation indicate that a homogeneous Al–U alloy containing at least 0.14 wt % B may be obtained by the chip method. The mechanical properties of this alloy are comparable to cast and hot-rolled U–Al alloy with the same U content. An exploratory investigation of blending Al–U shot plus B revealed that this method is also very promising for production of homogeneous B-bearing alloys. (J.R.D.)

22942 THE DANISH ATOMIC ENERGY COMMISSION AND ITS RESEARCH CENTER AT RISÖ. T. Bjerge (Forschungszentrums, Risø, Copenhagen). Atomwirtschaft, 8: 80-3(Feb. 1963). (In German)

The Danish Atomic Energy Commission established a research center for the study and development of nuclear energy at Risö. There are three reactors in operation at the center: Dr-1, a small 2-kw homogeneous reactor used for training and special studies; DR-2, a 5-Mw reactor cooled and moderated by light water, used for radioisotope production, materials testing, and neutron diffraction experiments; and DR-3, a heavy water cooled and moderated 10-Mw reactor, used for irradiation of fuel samples of Dragon and for studies of graphite and uranium. The use of radioisotopes and radiation in agricultural research has received much emphasis. (J.S.R.)

22943 THE INTERNATIONAL NORA PROJECT. V. O. Eriksen (Institutt for Atomenergi, Kjeller, Norway). Atomwirtschaft, 8: 127-9(Feb. 1963). (In German)

The Norwegian government proposed to the IAEA that this organization should promote a scientific program for measurement, evaluation, collection, and distribution of integral nuclear data. The zero-power reactor NORA with its facilities and scientific staff was made available for a joint program between the IAEA and the Norwegian IFA. The scientific program proposed was a study of reactor cores moderated with mixtures of light and heavy water. The offer was accepted, and the main features of the agreement signed between IAEA and Norway are tabulated. (J.S.R.)

22944 THE ISPRA-2 REACTOR. S. Barabaschi and R. Zona (CNEN, Rome). Energia Nucl. (Milan), 10: 195-208(Apr. 1963). (In Italian)

A description is given of the Ispra-2 reactor, sited at the Nuclear Studies Center of Casaccia, near Rome and owned by CNEN (the Italian Atomic Energy Commission). The Ispra-2 is a swimming-pool reactor having a maximum power level of 100 kw, and it is exclusively used for measurement of neutron spectra and of resonance integrals with the oscillation or activation method and for reactivity measurements. (auth)

22945 ORNL FAST BURST REACTOR (Engineering Materials). (Oak Ridge National Lab., Tenn.). 126 units. (CAPE-901)

This small research reactor is used to provide short bursts of radiation for bio-medical and health physics research at ORNL (see CAPE-900, Fast Burst Reactor Buildings). It consists mainly of a core of uranium molybdenum without shielding or a moderator. The reactor is in a building located in a hollow that is protected by surrounding hills. It will provide a pulse of 40 μsec (40 millionths of a second) consisting of fast neutrons. It can also operate under constant steady state conditions at low power levels up to one kw or high power steady state from 1 to 10 kw. The reactor may be operated from a dolly at various heights up to 30 ft or it may be moved outside for operation. (F.L.S.)

22946 ORNL FAST BURST REACTOR INSTRUMENTATION AND CONTROL (Engineering Materials). (Oak Ridge National Lab., Tenn.). 41 units. (CAPE-902)

Five main channels of instrumentation provide information to the control systems for the Fast Burst Reactor (see CAPES-900 and 901). These channels are the count rate, log N period, level safety, level control, and temperature safety. The reactor will not operate unless certain safety requirements are satisfied. If these conditions do not exist, the annunciator system is actuated. Some of these conditions are: safety monitor trouble; the log N period is less than 5 seconds; fast scram; fuel temperature too high; air pressure in cylinders too low; slow scram; etc. (F.L.S.)

22947 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR SYSTEMS. (to General Dynamics Corp.). British Patent 924,594. Apr. 24, 1963. Priority date, Jan. 31, 1961, United States.

A reactor is designed with a radiation shield of arcuate cross section and means for moving the shield into and out of the path of the radiation from the core to an irradiation zone. Thus, it is possible to first expose a specimen to both gamma rays and neutrons and then to neutrons only. (D.L.C.)

SPACE APPLICATIONS AND TECHNOLOGY

Refer also to abstract 21929.

22948 (AD-282977) INVESTIGATION OF A LINED-CAVITY DESTRUCT CHARGE CONCEPT. Final Report. E. E. Lockwood (Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.). Aug. 6, 1962. 47p. (R-3731)

A brief literature survey and experimental program was conducted to demonstrate the feasibility of utilizing a lined-cavity explosive destruct charge (shaped charge) concept for the airborne Small Nuclear Auxiliary Power (SNAP) reactor. Linear shaped-charge penetration tests were conducted against 1-in.-thick steel witness plate to optimize the charge configuration. A circular (continuous ring) shaped charge was then constructed and tested against a reactor mockup vessel. Satisfactory demonstration of the ring charge concept was achieved. The optimum charge configuration contained a linear explosive loading of 0.5 lb/ft. (auth)

22949 (LADC-5765) NUCLEAR AEROSPACE SAFETY PROBLEMS. L. D. P. King (Los Alamos Scientific Lab., N. Mex.). [Apr. 22, 1963]. Contract [W-7405-eng-36]. 14p.

Safety problems that have arisen in the conquest of space and are of a nuclear origin are discussed. Space radiation such as cosmic radiation, geomagnetically trapped corpuscular radiation, and solar flare radiation and radiations inherent in nuclear auxilliary power systems are considered. Problems created by the use of nuclear propulsion systems are emphasized. Launch pad problems and core disposal are discussed. (M.C.G.)

22950 (NAA-SR-8127) SURVEY OF METEOROID PROPERTY AND DISTRIBUTION DATA RELEVANT TO SNAP 8 REACTOR AND SHIELD DESIGN. C. R. Harder (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 30, 1963. Contract AT (11-1)-Gen-8. 40p.

A survey of existing literature relative to the properties and distributions of meteoroids is presented. Of major interest is prediction of the criteria which may be used to calculate the imparing effect of this meteoroidal phenomenon on the SNAP 8 space system and/or its components and other space vehicle structures. (auth)

22951 (NASA-TN-D-1579) PERFORMANCE CAPABILITY OF SINGLE-CAVITY VORTEX GASEOUS NUCLEAR ROCKETS. Robert G. Ragsdale (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1963. 67p.

A hydrodynamic analysis of two-component compressible vortex flow was used to determine hydrogen flow rates consistent with criticality requirements. Thrust per reactor weight was used as the criterion of performance, and a maximum value was determined for both laminar and turbulent flows. Hydrogen property variations are included in the hydrodynamic computer program that is described. The calculated variation of pertinent parameters with vortex radius is presented for a typical laminar example, and turbulence effects are discussed. Because of limits placed on hydrogen flow rate by the diffusion process, the performance capability of this system is less than that of an advanced solid-core nuclear rocket. (auth)

22952 (SID-62-127) ION AND ELECTRIC PROPULSION SYSTEMS FOR SPACE FLIGHT: A LITERATURE SURVEY. (North American Aviation, Inc. Space and Information Systems Div., Downey, Calif.). Mar. 1, 1962. 91p. (AD-282463)

A bibliography of ASTIA literature is presented along with selected items from periodical literature. A total of 335 items is included. (J.R.D.)

22953 (TID-18474) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Quarterly Technical Report, December 1, 1962–February 28, 1963. H. F. Poppendiek, N. D. Greene, F. R. MacDonald, and R. K. Livett (Geoscience Ltd., San Diego, Calif.). Contract AT(04-3)-409. 17p. (GLR-13)

The liquid metal heat transfer system that is shortly to be used to investigate fundamental boiling and condensing phenomena in liquid metals was sufficiently completed so that preliminary non-boiling water heat transfer experiments were conducted. The purpose of these studies was to establish the accuracy of the heat transfer instrumentation for the boiler test section, gain operating experience and obtain information on system integrity. Satisfactory heat balances were obtained and experimental heat transfer conductances for the boiler were found to be in agreement with predicted values. These experiments revealed that one boiler test section pressure tap had a leak in the weld. The results of coolant heat and momentum transfer analyses for the liquid metal program are summarized. A number of forced-flow saturation boiling models for the cases of linear and rotational flow are compared with experimental linear flow water data; large differences in heat transfer and friction were found depending upon the flow type postulated. The evaluation of a previously described two-phase flow vortex decay solution was completed. (auth)

22954 (TID-18558) NUCLEAR PROPULSION—AN EMERGING TECHNOLOGY. Harold B. Finger (Space Nuclear Propulsion Office, AEC/NASA). [1963]. 36p.

The use of nuclear energy in the space programs is discussed. Nuclear rocket development is reviewed, and the Nevada rocket development station, nuclear electric propulsion and power generation, and advanced research projects are discussed. (J.R.D.)

22955 THE PHYSICS OF SPACE RESEARCH. S. N. Ray (Borough Polytechnic, London). Brit. J. Appl. Phys., 14: 70-7(Feb. 1963).

Phenomena occurring at heights above 150 km which may be studied by rockets or satellites are outlined, and techniques for studying them are described briefly. (D.L.C.)

22956 PROBLEMS OF CYBERNETICS AND SPACE MEDICINE. V. V. Parin and R. M. Baevskii (Inst. of Normal and Pathological Physiology. Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Biol., No. 1, 9-14(Jan.-Feb. 1963). (In Russian)

Problems of cybernetics are discussed with reference to space medicine. The information theory is widely used for solving the problems relevant to radiotelemetric transmission of biological data. Construction of devices for automatic medical control of the condition of the crew of the space ship has a direct bearing to electron diagnostic machines. Mathematical methods and the computing technic are used for analyzing experimental evidence. The theory of automatic regulation was applied for modeling physiologi-

cal reactions, for developing closed ecological systems, and for solving the problems of driving space ships. The problems bearing on the modifications undergone by the information in the brain are of primary importance for the study of the effect of the space flight conditions upon the efficiency of man, the activity of his nervous system and of his analyzers. (P.C.H.)

22957 EXPERIMENTAL STUDIES IN COSMIC PHYSIOLOGY. P. V. Vasil'ev, A. D. Voskresenskii, and O. G. Gazenko. Izv. Akad. Nauk SSSR, Ser. Biol., No. 1, 15-23 (Jan.-Feb. 1963). (In Russian)

Two alternative modes of experimentation are considered: a study of a rather small number of standard physiological indices by reproducing the effect of certain factors of the actual cosmic flight; a study of the physiological mechanisms of the effect upon the organism of the same factors. The necessity and significance of experimental inquiry into the physiological mechanisms are illustrated by examples derived from transverse accelerations. A scheme of the major physiological effects of transverse accelerations is drawn. This is based on original studies in hemodynamics of pulmonary circulation, in oxygen consumption by the cardiac muscle, oxygen tension in the cerebral tissues, and the functions of the central nervous system as well as on literature data. It appears possible to describe the physiological changes quantitatively and to construct a model that would exhibit the major physiological changes in the organism under various conditions of cosmic flight. Such a model will afford a more substantiated estimate and prognosis of the status of the cosmonaut. It will reduce the number of experiments of the empirical type and indicate effective means for raising the resistivity of the organism to diverse conditions of the flight. (auth)

22958 STATUS AND TRENDS—SPACE PROPULSION. A. O. Tischler (National Aeronautics and Space Administration, Washington, D. C.). Mech. Eng., 85: 48-55(Mar. 1963).

Some of the equipment available and in development for space launch vehicles are briefly discussed. Thrust increases in approximately tenfold steps and the move toward hydrogen–oxygen as a propellant for upper stages are notable trends. The different propulsion requirements of the many spacecraft mission objectives are considered. The potential of nuclear rockets and electric rockets is discussed. The SNAP-8 electrical-generating system is described. (C.E.S.)

22959 REPORT ON SATELLITE AND SPACE PROPULSION SYSTEMS. Glauco Partel (Università, Rome). Riv. Aeron., 38: 549-93(Apr. 1962). (In Italian)

Low-thrust propulsion systems that can be used to extend satellite orbits, to control or modify satellite orbits, and for lunar and interplanetary exploration are surveyed. The most feasible combinations of energy sources (chemicals, radioisotopes, solar rays, nuclear fission, and nuclear fusion), electric generators (chemical batteries, radioisotope batteries, thermopiles, solar batteries, turboelectric generators, and plasma induction), and thrust generators (voltaic arc chambers, ion accelerators, plasma accelerators, and photon accelerators) to yield low-thrust propulsion systems are discussed. (J.S.R.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 21800.

22960 (CRER-1128) A STUDY OF DILUTION IN THE OTTAWA RIVER USING RHODAMINE B. I. NPD TO DEEP RIVER. W. F. Merritt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1962. 16p. (AECL-1712)

Rhodamine B, a fluorescent dye, was used to study dilution in the Ottawa River downstream of the NPD reactor site. Dye was injected into the NPD process sewer for a 3-hr period and the concentration measured as it dispersed in the river. An initial dilution of 100 was observed near the outfall. A wide, deep section of the Ottawa River downstream of the reactor site acted as a detention and mixing basin. Dye concentrations at the town of Deep River water intake, 16 km downriver, indicated a minimum overall dilution of the effluent of 3×10^4. The water velocity in that section of the Ottawa River was about 9 km per day. (auth)

22961 (JAERI-4021) RADIOACTIVE WASTE DISPOSAL IN EUROPE. S. Sakata (Japan Atomic Energy Research Inst., Tokyo). Oct. 31, 1962. 77p. (In Japanese)

Problems arising from the treatment and disposal of radioactive wastes are reviewed, comparing the European practice to that followed in Japan. Special attention is devoted to the methods practiced at the Mol Laboratory in Belgium; at the same time the systems in use at Saclay (France), Harwell (England), Seibersdorf (Austria), Karlsruhe (Germany), and Risø (Denmark) laboratories are also reviewed. On the basis of the material presented it is concluded that three separate philosophies govern the waste disposal facilities in Europe. After comparing the advantages and disadvantages of the systems, the specifically Japanese radioactive waste disposal problems are discussed. (TTT)

22962 THE RISØ DECONTAMINATION PLANT FOR LOW-LEVEL RADIOACTIVE EFFLUENTS. C. F. Jacobsen (Research Establishment, Risø, Denmark). Atomwirtschaft, 8: 111(Feb. 1963). (In German)

The procedure used at Risö for the decontamination of low-level radioactive effluents is described, with emphasis on the characteristics of the distillation process. A decontamination factor of about 10^5 is obtained. (J.S.R.)

22963 FEASIBILITY OF TREATMENT OF RADIOACTIVE WASTE. G. Sachse and I. Mittag (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 1-11 (Jan. 1963). (In German)

The methods for the purification of radioactive waste in different countries are reported. Chemical methods, chiefly precipitations (some with subsequent ion exchange), are described using the decontamination methods of the research institutes at Oak Ridge, Harwell, and Mol as an example. Proposals and methods of Soviet authors for the purification of waste from radiochemical operations and from biophysical and chemical laboratories are illustrated with flow diagrams. Methods used for the seepage of radioactive waste into the ground, which have been in use for some time at Hanford, the Savannah River Plant, and the Canadian installation at Chalk River, are reported. Distillation is used in Risö for decontamination. The description of the distillation installation and methods at Risö is given in conclusion. (tr-auth)

22964 URANIUM SCRAP BURNING FACILITY (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 5 building and 8 equipment drawings. (CAPE-910)

The building in which the uranium scrap is burned is 16 ft wide and 24 ft long with 6 ft wide rails 15 ft long that enter the building. The furnace is a gas burner with an insulated frame electrode. Details of the equipment including the mixer and furnace are included in this package. (F.L.S.)

CORPORATE AUTHOR INDEX

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	**becomes**	**ae**
ö		**oe**
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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.

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281728*	17-22150	$1.60(OTS)
281769*	17-22151	$1.10(OTS)
281948*	17-22405	See AFCRL-62-441
282156*	17-22710	$10.10(OTS)
282197*	17-22404	See AFCRL-62-379
282198*	17-21898	See AFCRL-62-380
282243*	17-22403	$5.60(OTS)
282306*	17-21971	$5.60(OTS)
282315*	17-22001	$3.60(OTS)
282398*	17-21972	$11.50(OTS)
282401*	17-21900	See D1-82-0181
282463*	17-22952	See SID-62-127
282895*	17-22263	See AFCRL-62-669
282916*	17-22715	See AFCRL-62-574
282941*	17-22724	See NRL-5808
282945*	17-22664	See ML-915
282968*	17-22529	$15.00(OTS)
282971*	17-22713	See AFCRL-62-555
282977*	17-22948	$5.60(OTS)
282994*	17-22267	See BSD-TDR-62-116
283041*	17-22711	$4.60(OTS)
283078*	17-22712	$6.60(OTS)
283089*	17-22714	See AFCRL-62-562
284576*	17-21393	See NRL-5814
284662*	17-22262	$6.60(OTS)
284982*	17-22766	See PA-TR-3009
285146*	17-22717	See EDL-M488
285188*	17-21958	$2.60(OTS)
285269*	17-21930	See NRL-5800
285409*	17-22087	$8.60(OTS)
285518*	17-22152	$1.60(OTS)
291066*	17-22153	
297538*	17-22549	See AROD-2543:8
401158*	17-22101	See WAL-TR-420.5/1
402106*	17-22414	$3.60(OTS)
402108*	17-22536	See SAM-TDR-63-18
402147*	17-22905	See BRL-1438
402293*	17-21934	See USNRDL-TR-631
402294*	17-21468	See USNRDL-TR-628
402406*	17-22126	$1.60(OTS)
402836*	17-22280	See USNRDL-TR-610
403032*	17-22281	See USNRDL-TR-623
404677*	17-22226	See REIC-Access-62(Pt.1)
404711	17-21876	See NP-12742
AEC-tr–		
5773	17-21960	Dep.(mc); $1.10(fs), $0.80(mf) JCL
5775	17-21961	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5781	17-22009	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5783	17-22569	Dep.(mc); $1.60(fs), $0.80(mf) JCL

Report No.	Abstract No.	Availability
AECL–	**(Canadian)**	
1712	17-22960	See CRER-1128
AEET-AM–	**(Indian)**	
27	17-21922	Dep.(mc)
30	17-21923	Dep.(mc)
32	17-21427	Dep.(mc)
AEET-Anal–	**(Indian)**	
6	17-22415	Dep.(mc)
AEET-CD–	**(Indian)**	
10	17-22782	Dep.(mc)
11	17-21593	Dep.(mc)
AEET-ROD–	**(Indian)**	
3	17-22904	Dep.(mc)
AERE-L–	**(British)**	
137	17-21924	
AERE-M–	**(British)**	
1192	17-22154	Dep.; $0.25(BIS); 1s. 9d. (HMSO)
AERE-R–	**(British)**	
4244	17-22002	Dep.; $0.77(BIS); 5s. 6d. (HMSO)
4253	17-21663	Dep.; $0.98(BIS); 7s. (HMSO)
4281	17-21664	Dep.; $0.16(BIS); 1s. 6d. (HMSO)
4299	17-22530	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
AERE-Trans–	**(British)**	
903	17-21981	Dep.; $1.60(fs), $0.80(mf) JCL
918	17-22071	Dep.; $3.60(fs), $1.16(mf) JCL
929	17-21737	Dep.; $2.60(fs), $0.92(mf) JCL
931	17-22103	Dep.
AFCRL–	**(Non-AEC)**	
62-379	17-22404	$8.10(OTS)
62-380	17-21898	$3.60(OTS)
62-441	17-22405	
62-555	17-22713	$4.60(OTS)
62-562	17-22714	$2.60(OTS)
62-574	17-22715	$4.60(OTS)
62-669	17-22263	$8.10(OTS)
62-1071	17-21899	
AFSWC-TDR–	**(Non-AEC)**	
62-118	17-22215	
AN–	**(Misc.)**	
664*	17-22711	See AD-283041
ANL–		
6675	17-21870	Dep.; $0.75(OTS)
6679	17-22264	Dep.; $8.60(fs), $2.99(mf) OTS
6685	17-21734	Dep.; $1.50(OTS)
6705	17-22783	Dep.; $1.75(OTS)
ARF–	**(Misc.)**	
3124-1	17-22784	Dep.(mc); $3.60(fs), $1.31(mf) OTS
ARF-B–	**(Misc.)**	
6005-5	17-22155	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ARL–	**(Non-AEC)**	
63-15	17-22156	OTS
AROD–	**(Misc.)**	
2543:8*	17-22549	
ASD-TDR–	**(Non-AEC)**	

Report No.	Abstract No.	Availability
62-203(Pt.II)	17-21665	OTS
62-1018	17-22157	OTS
63-160	17-22109	OTS
63-183	17-22265	OTS
63-296	17-22127	OTS
AWRE-E-	**(British)**	
6/63	17-21925	Dep.(mc)
AWRE-O-	**(British)**	
13/63	17-22158	Dep.
BAW-TM-	**(Non-AEC)**	
344	17-22785	
BM-IC-	**(Non-AEC)**	
8166	17-22266	Free(Bureau of Mines)
BM-RI-	**(Misc.)**	
6226	17-22088	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6240*	17-21666	Free(Bureau of Mines)
BMI-	**(Misc.)**	
1623	17-22216	Dep.; $1.25(OTS)
1626	17-22110	Dep.; $0.75(OTS)
BMI-X-		
221	17-22159	Dep.(mc); $1.10(fs), $0.80(mf) OTS
229	17-22111	Dep.(mc); $1.60(fs), $0.80(mf) OTS
BN-	**(Misc.)**	
6210-09	17-22138	See EURAEC-590
BNL-		
789	17-21386	Dep.; $0.50(OTS)
6367	17-21746	J. Polymer Sci., Pt. B, 1: 257-62(1963)
6603	17-22621	Phys. Rev. 130: 1541-8(1963)
6616	17-22607	Phys. Rev. 130: 1423-5(1963)
6625	17-22631	Phys. Rev. 130: 1953-60(1963)
6635	17-22626	Phys. Rev. 130: 1907-13(1963)
6657	17-22544	Phys. Rev. 130: 1670-6(1963)
6675	17-22193	Phys. Rev. 130: 1726-34(1963)
6931	17-22550	Dep.(mc); $2.60(fs), $0.83(mf) OTS
BNL-L-		
338	17-21386	See BNL-789
BRB-		
72	17-22089	Dep.(mc); $3.60(fs), $1.28(mf) OTS
BRL-	**(Misc.)**	
1438*	17-22905	$2.60(OTS)
BSD-TDR-	**(Non-AEC)**	
62-116	17-22267	$3.60(OTS)
CAPE-		
771	17-22055	EM
794	17-21851	EM
800	17-21852	EM
812(Rev.)	17-22056	EM
837	17-22057	EM
842	17-22058	EM
861	17-21853	EM
865	17-22059	EM
876	17-22764	EM
885	17-21854	EM
886	17-21855	EM
889	17-22060	EM
896	17-21996	EM
901	17-22945	EM
902	17-22946	EM
903	17-22829	EM
907	17-22830	EM
910	17-22964	EM
912	17-21856	EM
913	17-21857	EM
920	17-21858	EM
925	17-22061	EM
932	17-22062	EM
938	17-22063	EM
939	17-22085	EM
940	17-21997	EM
941	17-21859	EM
945	17-22528	EM
946	17-22064	EM
947	17-21860	EM
949	17-21861	EM
951	17-21862	EM
953	17-21897	EM
957	17-22065	EM
958	17-21998	EM
959	17-22687	EM
960	17-21863	EM
961	17-21864	EM
962	17-21865	EM
968	17-21866	EM
970	17-21999	EM
972	17-22895	EM
973	17-22896	EM
982	17-22066	EM
CEA-	**(French)**	
1955	17-22179	J. Phys. Soc. Japan 17: 285-8(1962)
2211	17-22906	Dep.(mc)
2255	17-22003	Dep.(mc)
2256	17-22090	Dep.(mc)
2258	17-22903	Dep.(mc)
CEA-Bib-	**(French)**	
30	17-22416	Dep.(mc)
CEA-tr-	**(French)**	
A-1177	17-22801	Dep.(mc); $2.60(fs), $1.04(mf) JCL
CERN-	**(European Organization for Nuclear Research)**	
63-7	17-22078	Dep.(mc)
63-8	17-22417	Dep.(mc)
63-9	17-22551	Dep.(mc)
CEX-		
58.4.8	17-21926	Dep.; $1.25(OTS)
CISE-	**(Italian)**	
93	17-22004	Dep.(mc)
CISE-R-	**(Italian)**	
53	17-21871	Dep.(mc); $9.10(fs), $3.35(mf) OTS
62	17-21872	Dep.(mc); $9.10(fs), $3.26(mf) OTS
63	17-21873	Dep.(mc); $5.60(fs), $1.73(mf) OTS
CRER-	**(Canadian)**	
1128	17-22960	Dep.; $0.50(AECL)
CTSL-		
39	17-22490	Phys. Rev. 130: 2089-97(1963)
D-	**(Misc.)**	
1-82-0181*	17-21900	$1.60(OTS)
1-82-0238*	17-22716	
DM-	**(Misc.)**	

Report No.	Abstract No.	Availability
26	17-21771	176p. of Tritium Labeling: Preparation, Measurement, and Application of Compounds Labeled by the Wilzbach Method in Medicine, Chemistry, Agriculture, Industry. (in German)
DMIC–	**(Non-AEC)**	
179	17-22128	
DP–		
739	17-21773	Dep.; $0.50(OTS)
814	17-21610	Dep.; $0.50(OTS)
820	17-21806	Dep.; $0.50(OTS)
835	17-22851	Dep.; $0.50(OTS)
DRI–	**(Misc.)**	
2094	17-22160	Dep.(mc); $7.60(fs), $2.36(mf) OTS
2096	17-22161	Dep.(mc); $5.60(fs), $1.73(mf) OTS
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EACRP-U–	**(Swiss)**	
6	17-22552	Dep.(mc)
EANDC(E)–	**(European-American Nuclear Data Committee)**	
43L	17-22553	Dep.(mc)
44L	17-22786	Dep.(mc)
EDL-M–	**(Non-AEC)**	
488	17-22717	$1.10(OTS)
EGCR-STUDY–		
IV-300(Rev.3)	17-22844	See ACNP-61528
IV-303-2(Rev.1)	17-22850	See ACNP-63507
IV-303-3(Rev.1)	17-22849	See ACNP-63506
IV-311	17-22859	See TID-18526
IV-311-1(Rev.1)	17-22847	See ACNP-62606
IV-311-2	17-22860	See TID-18527
IV-315(Rev.1)	17-22848	See ACNP-62608
EUR–	**(European Atomic Energy Community)**	
134.e	17-22787	Dep.(mc)
203.f	17-21611	Dep.(mc)
204.i	17-21612	Dep.(mc)
EURAEC–		
373	17-22104	Dep.(mc); $1.60(fs), $0.80(mf) OTS
503	17-22219	See GEAP-3771-6
508	17-22802	Dep.(mc); $3.60(fs), $1.34(mf) OTS
513	17-22169	Dep.(mc); $1.10(fs), $0.80(mf) OTS
516	17-22131	Dep.(mc); $3.60(fs), $1.19(mf) OTS
517	17-21873	See CISE-R-63
525	17-22132	Dep.(mc); $1.10(fs), $0.80(mf) OTS
526	17-22170	Dep.(mc); $4.60(fs), $1.52(mf) OTS
532	17-22133	Dep.(mc); $6.60(fs), $2.18(mf) OTS
535	17-22134	Dep.(mc); $2.60(fs), $0.83(mf) OTS
553	17-21671	Dep.(mc); $1.60(fs), $0.80(mf) OTS
557	17-22114	Dep.(mc); $3.60(fs), $1.19(mf) OTS
559	17-22115	Dep.(mc); $1.60(fs), $0.80(mf) OTS
560	17-22229	Dep.(mc); $1.60(fs), $0.80(mf) OTS
564	17-22135	Dep.(mc); $5.60(fs), $1.79(mf) OTS
567	17-22803	Dep.(mc); $1.60(fs), $0.80(mf) OTS
573	17-22116	Dep.(mc); $4.60(fs), $1.52(mf) OTS
580	17-22804	Dep.(mc); $7.60(fs), $2.54(mf) OTS
585	17-22136	Dep.(mc); $5.60(fs), $1.82(mf) OTS
586	17-22137	Dep.(mc); $9.60(fs), $3.80(mf) OTS
587	17-22005	Dep.(mc); $5.60(fs), $1.94(mf) OTS
589	17-21872	See CISE-R-62
590	17-22138	Dep.(mc); $2.60(fs), $1.10(mf) OTS
595	17-21871	See CISE-R-53
641	17-22790	See GNEC-275
654	17-22166	See NCSC-2663-11
FZM–	**(Non-AEC)**	
1042	17-22554	
GA–	**(Misc.)**	
2696	17-22852	Dep.(mc); $8.60(fs), $3.05(mf) OTS
3197	17-22217	Dep.(mc); $3.60(fs), $1.34(mf) OTS
3676	17-22853	Dep.; $1.25(OTS)
4164*	17-22218	
GAMD–	**(Misc.)**	
1130	17-22091	Dep.(mc); $3.60(fs), $1.40(mf) OTS
GAT-R–		
313	17-21927	Dep.(mc); $5.60(fs), $1.94(mf) OTS
GE–	**(Non-AEC)**	
63FPD66	17-22092	
GEAP–	**(Misc.)**	
3771-6	17-22219	Dep.(mc); $8.10(fs), $2.84(mf) OTS
3935	17-22854	Dep.(mc); $7.60(fs), $2.33(mf) OTS
3940	17-22788	Dep.; $1.00(OTS)
4165	17-22112	Superseded by GEAP-4165A
4165A	17-22112	Dep.(mc); $4.60(fs), $1.58(mf) OTS
GEMP–		
21A	17-22093	Dep.; $0.75(OTS)
173	17-22789	Dep.(mc); $3.60(fs), $1.25(mf) OTS
186	17-22162	Dep.; $0.75(OTS)
GLR–		
13	17-22953	See TID-18474
GMX–		
2-R-63-1	17-22279	See TID-18571
GNEC–		
275	17-22790	Dep.(mc); $8.60(fs), $2.99(mf) OTS
HASL–		
126	17-22531	Dep.; $1.00(OTS)
HW–		
64564	17-22791	$1.60(fs), $0.80(mf) OTS
67072	17-22221	Dep.; $1.25(OTS)
67418	17-22792	Dep.(mc); $5.60(fs), $1.91(mf) OTS
68525	17-22006	Dep.; $1.25(OTS)
68984	17-22793	$3.60(fs), $1.37(mf) OTS
70543	17-21667	Dep.; $1.00(OTS)
71023	17-22094	Dep.; $0.50(OTS)
71044	17-22079	Dep.; $0.50(OTS)
74783	17-21973	Dep.; $1.00(OTS)
HW-SA–		
2280	17-21466	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3030	17-21928	Dep.(mc); $1.10(fs), $0.80(mf) OTS
HWS–		
5963	17-22100	See TID-18523
IA–	**(Non-AEC)**	
787	17-22163	Dep.(mc)
IDO–		
11003	17-22794	Dep.(mc); $5.60(fs), $1.91(mf) OTS
11221	17-22795	Dep.; $1.50(OTS)
12029	17-22007	Dep.; $2.00(OTS)
16809	17-21974	Dep.; $0.50(OTS)

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16850	17-22220	Dep.; $0.50(OTS)
IPPJ–	**(Japanese)**	
6	17-22718	Dep.(mc)
8	17-22719	Dep.(mc)
IS–		
409	17-22268	Dep.(mc); $2.60(fs), $0.83(mf) OTS
573	17-22337	Phys. Chem. Solids 24: 501-6(1963)
582	17-22476	Phys. Rev. 130: 1455-9(1963)
ISS–	**(Italian)**	
62/7	17-22418	Dep.(mc)
63/1	17-22419	Dep.(mc)
63/2	17-22080	Dep.(mc)
63/3	17-21975	Dep.(mc)
JAERI–	**(Japanese)**	
4021	17-22961	
JINR–	**(Russian)**	
D-1191	17-22420	Dep.(mc)
E-1210	17-22421	Dep.(mc)
E-1227	17-22422	Dep.(mc)
P-1205	17-22423	Dep.(mc)
P-1213	17-22424	Dep.(mc)
P-1214	17-22555	Dep.(mc)
P-1215	17-22269	Dep.(mc)
P-1217	17-22425	Dep.(mc)
P-1218	17-22556	Dep.(mc)
P-1221	17-22426	Dep.(mc)
P-1223	17-22557	Dep.(mc)
P-1244	17-22558	Dep.(mc)
JPRS–	**(Non-AEC)**	
18823	17-22282	$6.00(OTS)
18868	17-21738	$0.50(OTS)
18920	17-22171	$0.50(OTS)
18936	17-21428	$0.50(OTS)
18938	17-21469	$0.50(OTS)
19066	17-21577	$0.50(OTS)
K–		
1460	17-22164	Dep.(mc); $1.60(fs), $0.80(mf) OTS
KAPL–		
2165-1	17-22532	Dep.; $3.50(OTS)
2216	17-21668	Dep.; $0.50(OTS)
KFK–	**(German)**	
130	17-22907	Dep.(mc)
KFK-tr–	**(German)**	
123	17-21739	Dep.(mc); $2.60(fs), $1.10(mf) JCL
KR–	**(Norwegian)**	
39	17-22113	Dep.(mc)
42	17-21387	Dep.(mc)
LA–		
2880	17-22165	Dep.; $2.50(OTS)
LADC–		
5253	17-22611	Phys. Rev. 130: 1475-81(1963)
5494	17-22605	Phys. Rev. 129: 2239-52(1963)
5551	17-22559	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5556	17-22323	J. Mol. Spectry. 10: 232-4(1963)
5570	17-22339	Phys. Chem. Solids 24: 591-2(1963)
5593	17-22617	Phys. Rev. 130: 1512-22(1963)
5595	17-22628	Phys. Rev. 130: 1926-30(1963)
5604	17-22346	Phys. Rev. 130: 1406-11(1963)
5609	17-22008	Dep.(mc); $2.60(fs), $0.95(mf) OTS
5621	17-22486	Phys. Rev. 130: 1987-9(1963)
5765	17-22949	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5766	17-21874	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5771	17-22270	Dep.(mc); $6.60(fs), $2.18(mf) OTS
5775	17-21807	Dep.(mc); $1.10(fs), $0.80(mf) OTS
LAMS–		
2875	17-22855	Dep.; $0.50(OTS)
2894	17-22856	Dep.; $0.50(OTS)
LNF–	**(Italian)**	
62/99	17-22427	Dep.(mc)
63/11	17-21388	Dep.(mc)
63/16	17-22428	Dep.(mc)
63/19	17-22429	Dep.(mc)
MAB–	**(Non-AEC)**	
176-M	17-22095	Superseded by MAB-192-M
192-M	17-22095	
MITNE–	**(Misc.)**	
25	17-22796	Dep.; $1.50(OTS)
ML–	**(Misc.)**	
915*	17-22664	$10.10(OTS)
MLM–		
1145	17-21389	Dep.; $3.60(fs), $1.37(mf) OTS
MMPP–	**(Misc.)**	
235-1	17-22720	Dep.(mc); $5.60(fs), $1.85(mf) OTS
MMPP-NPC–		
1-1	17-22533	Dep.(mc); $4.60(fs), $1.52(mf) OTS
1-2	17-22534	Dep.(mc); $6.60(fs), $2.24(mf) OTS
1-3	17-22222	Dep.(mc); $9.60(fs), $3.56(mf) OTS
1-4	17-22271	Dep.(mc); $5.60(fs), $1.73(mf) OTS
MND–	**(Misc.)**	
1963	17-21929	Dep.(mc); $2.60(fs), $0.86(mf) OTS
2903(Vol.I)	17-22857	Dep.; $3.00(OTS)
2945-2*	17-22272	
MND-MC–	**(Non-AEC)**	
2856	17-22535	
MND-P–		
2835	17-22273	Dep.; $2.25(OTS)
MPR-XIII–		
3-63	17-21878	See TID-18512
NAA-SR–		
7395	17-22223	Dep.; $1.00(OTS)
8127	17-22950	Dep.; $0.75(OTS)
NASA-TN–	**(Misc.)**	
D-1534*	17-21875	$0.75(OTS)
D-1579*	17-22951	$1.75(OTS)
D-1636*	17-22721	$0.75(OTS)
D-1659*	17-22722	$1.00(OTS)
NBL–		
194	17-21976	Dep.; $0.50(OTS)
NCSC–	**(Misc.)**	
2663-11	17-22166	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NLCO–		
873	17-21772	Dep.(mc); $2.60(fs), $1.01(mf) OTS

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NMI–	**(Misc.)**	
7215DE	17-22797	Dep.(mc); $3.60(fs), $1.13(mf) OTS
7218-2	17-22096	Dep.(mc); $3.60(fs), $1.28(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
12591(Pt.I)	17-22430	Dep.(mc)
12591(Pt.II)	17-22431	Dep.(mc)
12610	17-22432	Dep.(mc)
12643	17-22560	
12658	17-22561	
12659	17-22908	
12660	17-22562	
12661	17-22433	
12663	17-22563	
12721	17-22274	Dep.(mc)
12722	17-22097	Dep.(mc)
12724	17-22858	Dep.(mc)
12725	17-22275	Dep.(mc)
12726	17-21774	Dep.(mc)
12727	17-22434	Dep.(mc)
12729	17-21390	Dep.(mc)
12730	17-22435	Dep.(mc)
12731	17-22129	
12732	17-22224	OTS
12737	17-21391	Dep.(mc)
12741	17-22723	
12742	17-21876	$3.60(OTS) as AD-404711
12743	17-21724	
12749	17-21392	Dep.; $1.96(BIS); 14s. (HMSO)
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
993	17-22570	Dep.(mc); $2.60(fs), $0.95(mf) JCL or OTS
994	17-21982	Dep.(mc); $1.10(fs), $0.80(mf) JCL
995	17-21962	Dep.(mc); $1.10(fs), $0.80(mf) JCL
996	17-21935	Dep.(mc); $1.60(fs), $0.80(mf) JCL
997	17-21882	Dep.(mc); $3.60(fs), $1.28(mf) JCL
1000	17-22291	Dep.(mc); $1.10(fs), $0.80(mf) JCL
1003	17-22571	Dep.(mc); $6.60(fs), $2.30(mf) JCL
NRL–	**(Misc.)**	
5800*	17-21930	$0.50(OTS)
5808*	17-22724	$2.60(OTS)
5814*	17-21393	$2.25(OTS)
NYO–		
9459	17-22276	Dep.(mc); $7.60(fs), $2.33(mf) OTS
10207	17-22796	See MITNE-25
10248	17-22461	Nuovo Cimento (10), 28: 56-65(1963)
10301	17-22798	Dep.; $3.00(OTS)
ORA–	**(Misc.)**	
03763-11P	17-22667	See TID-18578
ORNL–		
3300(Vol.2)	17-21394	Dep.; $3.50(OTS)
3381	17-21775	Dep.; $1.50(OTS)
3383	17-22564	Dep.; $3.00(OTS)
3428	17-22081	Dep.(mc); $0.50(OTS)
3440	17-22436	Dep.; $0.50(OTS)
ORNL-TM–		
355	17-21594	Dep.(mc); $8.60(fs), $3.05(mf) OTS
410	17-21776	Dep.(mc); $4.60(fs), $1.46(mf) OTS
441	17-21777	Dep.(mc); $8.60(fs), $2.93(mf) OTS
456	17-22909	Dep.(mc); $7.60(fs), $2.57(mf) OTS
479	17-22725	Dep.(mc); $4.60(fs), $1.64(mf) OTS
522	17-21778	Dep.(mc); $8.10(fs), $2.84(mf) OTS
534	17-21877	Dep.(mc); $4.60(fs), $1.46(mf) OTS
550	17-22665	Dep.(mc); $1.60(fs), $0.80(mf) OTS
569	17-21931	Dep.(mc); $1.60(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
ORO–		
587(Vol.III)	17-21932	Dep.; $3.00(OTS)
601	17-21959	Dep.; $0.75(OTS)
OTS–	**(Misc.)**	
62-11069*	17-21578	$3.75(OTS)
63-21632*	17-22282	See JPRS-18823
63-21657*	17-21738	See JPRS-18868
63-21690*	17-22171	See JPRS-18920
63-21695*	17-21428	For translation see JPRS-18936
63-21696*	17-21469	For translation see JPRS-18938
63-21754*	17-21577	For translation see JPRS-19066
PA-TR–	**(Non-AEC)**	
3009	17-22766	$3.60(OTS)
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
921,261	17-21867	
924,137	17-21895	
924,140	17-22831	
924,156	17-22067	
924,183	17-21868	
924,211	17-22832	
924,213	17-22898	
924,235	17-21608	
924,262	17-22833	
924,410	17-21802	
924,415	17-21609	
924,594	17-22947	
PATENTS	**(German)**	
1,143,591	17-22068	
1,143,792	17-22076	
1,143,935	17-22069	
1,143,936	17-22899	
1,144,249	17-21803	
1,144,412	17-22900	
1,144,413	17-22834	
1,144,697	17-22077	
1,144,854	17-21662	
1,144,855	17-22708	
1,145,722	17-22901	
1,145,723	17-22835	
PATENTS	**(U. S.)**	
3,084,055	17-21723	
3,088,671	17-22086	
3,088,800	17-21804	
3,088,890	17-22836	
3,088,891	17-22837	
3,088,892	17-22838	
3,088,894	17-22765	
3,088,895	17-22839	
3,088,904	17-22840	
3,089,092	17-22709	
3,089,098	17-22000	
3,089,751	17-21805	
3,089,768	17-22148	
3,089,830	17-22841	
3,089,838	17-22842	
3,089,839	17-22843	
3,089,840	17-22902	
3,089,957	17-21957	
3,090,117	17-22149	
3,090,480	17-21869	
3,090,894	17-22400	
PATENTS	**(U.S.S.R.)**	
144,848	17-21733	
145,779	17-22070	

Report No.	Abstract No.	Availability
PG-Report–	**(British)**	
219	17-21613	Dep.
232	17-21614	Dep.; $0.28(BIS); 2s. (HMSO)
278	17-21637	Nucleonics 21, No. 5: 78;80-1(1963)
375	17-21615	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
376	17-21616	Dep.
432	17-21617	Dep.; $0.28(BIS); 2s. (HMSO)
PNE–	**(Misc.)**	
213F*	17-21395	Dep.; $1.50(OTS)
217P	17-21396	Dep.; $1.50(OTS)
224F	17-21397	Dep.; $1.00(OTS)
228P	17-21398	Dep.; $1.00(OTS)
235F	17-21399	Dep.; $1.25(OTS)
R–	**(Misc.)**	
3731*	17-22948	See AD-282977
RADC-TDR–	**(Misc.)**	
62-241*	17-22664	See ML-915
RD–	**(Misc.)**	
62-952	17-22798	See NYO-10301
REIC–	**(Non-AEC)**	
25	17-22225	
REIC-Access–	**(Non-AEC)**	
62(Pt.I)	17-22226	$4.60(OTS) as AD-404677
RHD–	**(Non-AEC)**	
Vol.III, No.11	17-21954	$0.50(GPO)
Vol.IV, No.4	17-21955	$0.50(GPO)
RT-CHI–	**(Italian)**	
(63)-4	17-21735	Dep.(mc)
(63)-6	17-21618	Dep.(mc)
S–	**(Misc.)**	
467*	17-22152	See AD-285518
477*	17-22151	See AD-281769
SAM-TDR–	**(Non-AEC)**	
63-18	17-22536	$1.10(OTS)
SB–	**(Non-AEC)**	
62-22	17-22098	OTS
62-47	17-22224	See NP-12732
62-64	17-22099	OTS
63-5	17-22129	See NP-12731
SCDC–		
2857	17-22454	See TID-16864
2998	17-22360	See TID-17801
SCL-T–		
475	17-22292	Dep.(mc); $2.60(fs), $1.10(mf) JCL
480	17-21672	Dep.(mc); $2.60(fs), $0.98(mf) JCL
SCPRI(RM)–	**(French)**	
1-63	17-21457	Dep.(mc)
SCR–		
483	17-22082	Dep.; $4.00(OTS)
609	17-21984	J. Appl. Phys. 30: Suppl. 241s-3s(1959)
SCTM–		
71-63(24)	17-21977	Dep.; $0.50(OTS)
SEP–		
232	17-22130	Dep.(mc); $3.61(fs), $1.31(mf) OTS
SID–	**(Non-AEC)**	
62-127	17-22952	$8.60(OTS)
SIT-P–	**(Misc.)**	
91	17-22726	Dep.(mc); $9.10(fs), $3.44(mf) OTS
SLAC–		
13	17-22437	Dep.; $2.25(OTS)
STL–	**(Misc.)**	
8665-6002-RU-000*	17-22414	See AD-402106
TID–		
3716	17-21400	Dep.; Free(DTI Extension)
7642	17-22910	Dep.; $7.50(OTS)
15266	17-22565	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16864	17-22454	J. Math. Phys. (N. Y.) 4: 388-91(1963)
17029	17-22614	Phys. Rev. 130: 1500-3(1963)
17100	17-21890	J. Heat Transfer, 85: 182-3(1963)
17801	17-22360	Phys. Rev. 130: 1852-9(1963)
17873	17-22610	Phys. Rev. 130: 1472-4(1963)
18182	17-22623	Phys. Rev. 130: 1877-90(1963)
18183	17-22624	Phys. Rev. 130: 1891-1901(1963)
18188	17-22627	Phys. Rev. 130: 1914-25(1963)
18323	17-22277	Dep.(mc); $10.50(fs), $4.19(mf) OTS
18362	17-22619	Phys. Rev. 130: 1525-9(1963)
18366	17-22638	Phys. Rev. 130: 2022-5(1963)
18371	17-22475	Phys. Rev. 130: 1334-6(1963)
18373	17-22642	Phys. Rev. 130: 2054-60(1963)
18474	17-22953	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18478	17-22083	Dep.(mc); $5.60(fs), $1.73(mf) OTS
18481	17-22537	Dep.(mc); $8.60(fs), $2.96(mf) OTS
18504	17-21933	Dep.(mc); $12.00(fs), $5.24(mf) OTS
18512	17-21878	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18523	17-22100	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18524	17-22799	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18526	17-22859	Dep.(mc); $9.10(fs), $3.32(mf) OTS
18527	17-22860	Dep.(mc); $7.60(fs), $2.60(mf) OTS
18540	17-22727	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18543	17-22278	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18545	17-21978	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18549	17-21467	Dep.(mc); $4.60(fs), $1.58(mf) OTS
18556	17-21879	Dep.(mc); $10.10(fs), $3.83(mf) OTS
18558	17-22954	Dep.(mc); $3.60(fs), $1.28(mf) OTS
18560	17-21979	Dep.(mc); $2.60(fs), $0.98(mf) OTS
18561	17-22666	Dep.(mc); $5.60(fs), $1.79(mf) OTS
18565	17-22538	Dep.(mc); $2.60(fs), $1.10(mf) OTS
18566	17-21808	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18569	17-21880	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18571	17-22279	Dep.(mc); $3.60(fs), $1.13(mf) OTS
18577	17-22227	Dep.(mc); $3.60(fs), $1.22(mf) OTS
18578	17-22667	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18585	17-21401	Dep.(mc); $17.50(fs), $8.33(mf) OTS
18587	17-22539	Dep.(mc); $12.00(fs), $5.24(mf) OTS
18589	17-22668	Dep.(mc); $4.60(fs), $1.61(mf) OTS
18590	17-22566	Dep.(mc); $3.60(fs), $1.28(mf) OTS
18600	17-22406	Dep.(mc); $2.60(fs), $0.95(mf) OTS
TRG-Inf.–	**(British)**	
Ser.-202	17-21619	Dep.; $1.60(fs), $0.80(mf) JCL
Ser.-267	17-21883	Dep.; $1.10(fs), $0.80(mf) JCL
Ser.-287	17-21811	Dep.(mc); $1.10(fs), $0.80(mf) JCL
Ser.-291	17-21884	Dep.; $1.10(fs), $0.80(mf) JCL
TRG-Report–	**(Non-AEC)**	
447	17-21881	Dep.; $0.42(BIS); 3s. (HMSO)
463	17-22800	Dep.; $0.25(BIS); 1s. 9d. (HMSO)
UAC–		
6000	17-22565	See TID-15266

Report No.	Abstract No.	Availability
6791	17-21890	See TID-17100
7117	17-22623	See TID-18182
7135	17-22624	See TID-18183
7148	17-22627	See TID-18188
7149	17-22610	See TID-17873
7179	17-22475	See TID-18371
7192	17-22642	See TID-18373
7193	17-22619	See TID-18362
UCRL–		
5217(Rev.1)	17-22609	Phys. Rev. 130: 1471-2(1963)
7238	17-21669	Dep.; $2.25(OTS)
7291	17-21809	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9884(Rev.)	17-22622	Phys. Rev. 130: 1554-67(1963)
9938	17-22636	Phys. Rev. 130: 2000-10(1963)
10106	17-22616	Phys. Rev. 130: 1505-11(1963)
10198	17-22167	Dep.(mc); $4.60(fs), $1.49(mf) OTS
10244(Rev.)	17-22489	Phys. Rev. 130: 2077-9(1963)
10284	17-22641	Phys. Rev. 130: 2044-53(1963)
10443	17-22319	J. Math. Phys. (N. Y.) 4: 354-6(1963)
10462	17-21670	Dep.; $2.25(OTS)
10499	17-21980	Dep.; $1.75(OTS)
10547	17-22480	Phys. Rev. 130: 1568-70(1963)
10561	17-22669	Dep.; $0.50(OTS)
10645	17-22640	Phys. Rev. 130: 2042-3(1963)
10663	17-22620	Phys. Rev. 130: 1530-7(1963)
10673	17-22567	Dep.; $2.00(OTS)
10758	17-22670	Dep.(mc); $2.60(fs), $1.04(mf) OTS
10759	17-22671	Dep.(mc); $2.60(fs), $1.01(mf) OTS
UCRL-Trans–		
945(L)	17-22728	Dep.(mc); $2.60(fs), $0.83(mf) JCL or OTS
USNRDL-TR–	**(Non-AEC)**	
610	17-22280	$1.60(OTS)
623	17-22281	$1.60(OTS) as AD-403032
628	17-21468	$2.60(OTS)
631	17-21934	$1.60(OTS)
632	17-21736	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WADD-TD–	**(Non-AEC)**	
60-143(Pt.IV)	17-22168	OTS
WAL-TR–	**(Non-AEC)**	
420.5/1	17-22101	$1.60(OTS)
851.5/1	17-22102	$0.50(OTS)
WASH–		
1041	17-22568	Dep.; $1.25(OTS)
Y–		
1413	17-21810	Dep.; $1.75(OTS)
ZFK-WF–	**(German)**	
15	17-22228	Dep.(mc)